Evaluation of CRS Credited Activities During Hurricane Floyd

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TO

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Prepared by

The Hazard Mitigation Technical Assistance Partnership, Inc.
French & Associates, Ltd.
153 Nanti Street
Park Forest, IL 60466
708/747-5273 Fax: 708/747-5279
E-mail: FrenchAsoc@aol.com

Under Contract to

URS Greiner Woodward Clyde Federal Services
200 Orchard Ridge Drive, Suite 101
Gaithersburg, MD 20878
301/258-9780

Contents

Executive Summary

This report reviews the performance of several communities' Community Rating System (CRS) activities during and after the flooding caused by 1999's Hurricane Floyd in North Carolina. Using a combination of data collected in the field, data from flood insurance claims, and interviews with local officials and residents, the project team evaluated the impact of eight CRS activities on flood losses.

While some data problems are noted, the project team was able to measure the impact of the following activities and elements:

300 Series – Public Information Activities
- 320 – Map Information
- 330 – Outreach Projects
- 360 – Flood Protection Assistance

400 Series – Mapping and Regulations
- 410 – Additonal Flood Data
- 420 – Open Space Preservation
- 430 – Higher Regulatory Standards: Freeboard
- 430 – Higher Regulatory Standards: Coastal Regulations
- 430 – Higher Regulatory Standards: Enclosures

500 Series – Flood Damage Reduction
- 520 – Acquisition and Relocation
- 530 – Retrofitting

The findings are summarized by series:

300 Series – Public Information Activities: Residents of CRS communities: had a higher level of awareness that they were exposed to a flood hazard, had a higher level of flood insurance coverage, and had implemented more flood protection measures. However, when asked where they got the information for these things, we found no significant impact due to community-run public information programs.

400 Series – Mapping and Regulations:

- The combination of having base flood elevations and requiring new construction to be built to a freeboard of two feet above the BFE saved nearly $100,000 in the small community of Severn.

- The average savings from preserving floodprone areas as open space ranged from $47,500 to $111,000 per acre.

- Requiring a freeboard of one or two feet of additional protection above the base elevation can provide up to twice the savings that result from meeting the minimum NFIP requirement (as measured as a percentage of the building's value).

- Erosion protection regulations that require buildings to be set more than 100 feet back resulted in 1/3 the damage suffered when compared to buildings that are set back only 30 feet.

- Both piling depth and enclosure size can significantly affect the value of the flood loss for structures along the shoreline.

500 Series – Flood Damage Reduction:

- Acquisition and relocation of floodprone buildings is more effective at reducing flood losses than any other approach. Using the replacement cost of the flooded buildings, the theoretical benefit/cost ratio was 1.3:1. Using actual experience, 1996 – 1999, FEMA and the community had a payback in three years.

- The practice of elevating above the base flood elevation paid off: the higher the building, the less the damage.

- Where people had installed flood protection measures, they proved effective against Hurricane Floyd's flooding in 75% of the cases. 60% of those who had successful retrofitting projects saved over $5,000 in flood damage prevented. The average savings for all retrofitters was $9,900.

Overall Impact of the CRS. In addition to evaluating individual activities, local officials were interviewed on the impact of the CRS in general on their flood protection programs.

- The CRS was the cause for starting or modifying some local activities. However, in many cases it was not the only cause and it was overshadowed by recent flooding and disaster assistance funds.
- The CRS had a greater impact on activities that are inexpensive or can be implemented with current staff resources (e.g., public information and flood warning).

Introduction

Background

Since 1990, the Community Rating System (CRS) of the National Flood Insurance Program (NFIP) has provided flood insurance premium discounts in recognition of local floodplain management programs that exceed the minimum requirements of the NFIP. The amount of the discount depends on the number of activities a community implements and the sum of the scores for each activity.

Because the CRS represented an entire new way to observe and measure local floodplain management activities, there were few direct experiences or proven ways to determine how many points an activity should be awarded. Accordingly, the system to score a community's program was developed based on the combined professional judgment of contractors, FEMA staff and the CRS Task Force. A more objective way to confirm or improve the credit criteria and the scoring system could be developed from an evaluation of the effectiveness of specific CRS activities in response to actual flood events.

This report will review the performance of several communities' CRS activities during and after the flooding caused by 1999's Hurricane Floyd in North Carolina. It builds on the lessons learned from a previous report conducted in 1997 following Hurricanes Bertha and Fran in North Carolina.

It is assumed that the reader is familiar with both the NFIP and the CRS. Basic terms and NFIP regulations are not explained. Regulations and programs peculiar to North Carolina are explained.

Area Flood History

Before 1996. Historically, North Carolina has been subject to numerous flooding incidents. Most are of a local nature and occur almost routinely with low areas being inundated. However, the State has incurred severe flooding on numerous occasions, generally in conjunction with a hurricane.

Coastal North Carolina is one of the more vulnerable areas to hurricanes along the coastline of the United States. Since 1886, more than 50 hurricanes have directly affected North Carolina. On the average, North Carolina experiences a hurricane approximately once every two years.

Before the flooding associated with Hurricanes Fran and Floyd, the most extensive and destructive inland flood of record in the state occurred during July 1916. This flood resulted from extensive rain from a tropical storm. A record 1-day rainfall amount for the U.S. of 22.2 inches was recorded in the headwaters of the Nolichucky River at Altapass.

Streams reached flood stage in the central and northern areas of the Blue Ridge, and in the western Piedmont, from the Yadkin to the Pee Dee Rivers. The French Broad River rose more than nine feet above flood stage at Asheville. About 80 people were killed from floods and landslides, and damage was estimated at $11,000,000 to property and $11,000,000 to crops.

In August and September 1928, heavy rainfall from tropical storms flooded rivers in two separate regions in the southern half of the state. On August 15 and 16, a hurricane deposited more than 10 inches of rain in the headwaters of the French Broad and Broad Rivers and their tributaries. On September 17 and 18, rain from a second hurricane triggered record floods on the lower Cape Fear River and its tributaries, the Lumber River, and many smaller streams. The water level of the Cape Fear River rose 30 feet above flood stage at Fayetteville.

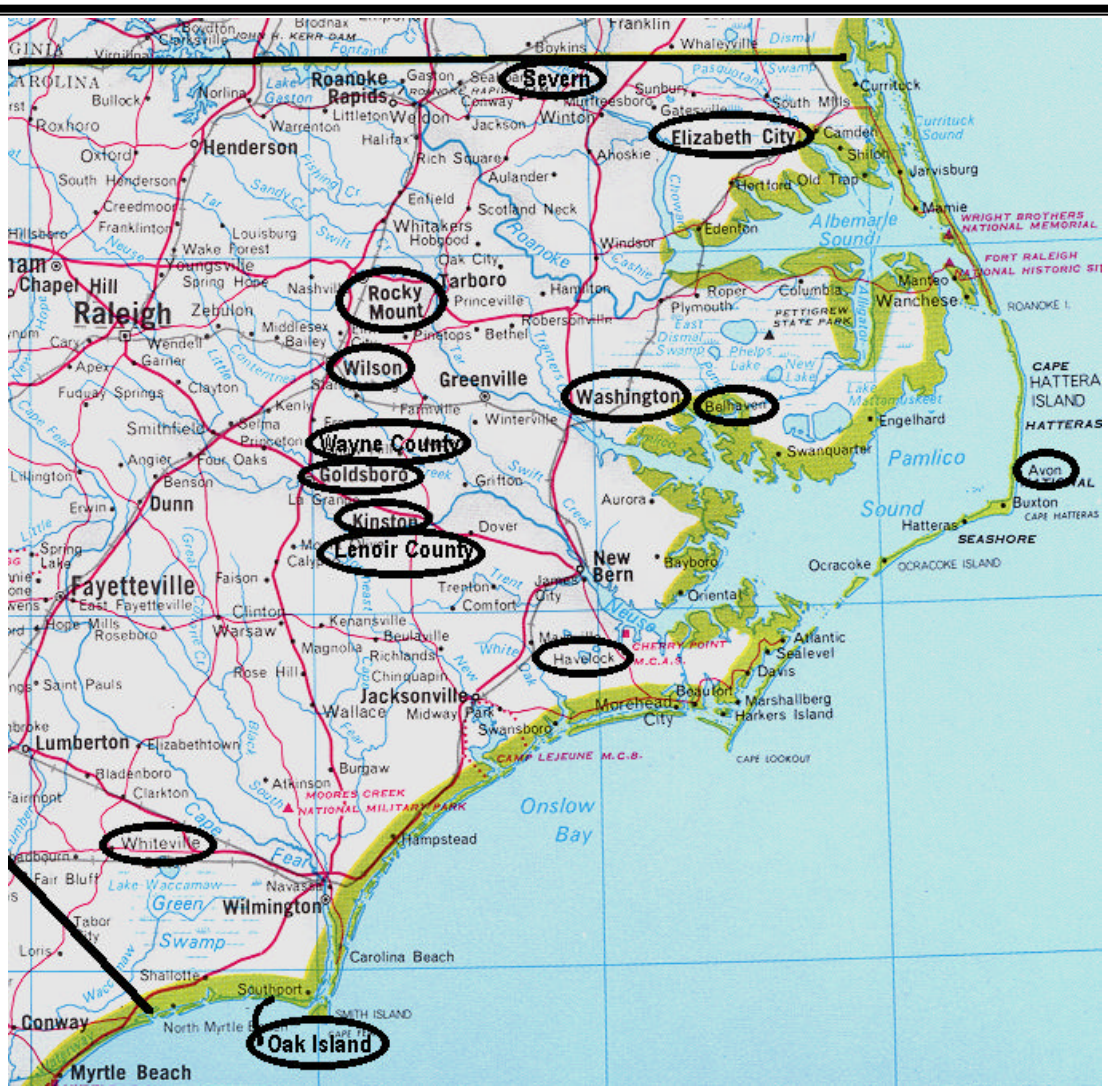
The most destructive flood along rivers in the eastern Piedmont resulted from a fast-moving hurricane that moved through on September 17, 1945. Following 3 to 5 days of intense rainfall, additional torrents of as much as 8 inches caused floods of major proportions along rivers in the upper Neuse, Haw, Cape Fear, Lumber, Rocky, and Lower Pee Dee River basins.

On September 21, 1945, the stage of the Cape Fear River at Fayetteville surpassed the 1928 flood record and set a new record at 68.9 feet, which was 34 feet above flood stage. Lowlands along the Cape Fear River were flooded for 8 days. Floodwater caused major damage to cropland and reached the eaves of many homes along the lower Cape Fear River. However, there was little loss of life.

In 1954 and 1955, flooding from hurricanes in eastern North Carolina caused the most extensive coastal flooding and destruction in recent times. Hurricanes in 1913 and 1933 produced higher flood levels, but they were less damaging because development was not as prevalent. Flooding from Hurricane Hazel on October 15, 1954, killed 19 people and caused about $31 million in damage to coastal areas. The coastal areas that were most damaged extended from the South Carolina border to Cape Lookout; however, record tidal flooding inundated areas as far north as Elizabeth City. Record rainfall resulted in extensive inland flooding of the Coastal Plain and rivers in the eastern Piedmont as well. Statewide, damage was about $125 million.

In 1957, Hurricanes Connie (August 12) and Diane (August 17) struck coastal areas. The greatest water damage from these two storms was to farms and communities along the Neuse and Pamlico River estuaries, where damage totaled $58 million. Hurricane Ione, on September 19, moved on a northeastward course near Morehead City. Lands that had been inundated a month before were again submerged; however, flood tides covered a more extensive area--from the New River to the Chowan River. Seven people were killed, and damage was $88 million. One-half of the damage was to agriculture.

In September 1989 Hurricane Hugo hit the South Carolina coast with Category 4 strength winds and then moved northwest into the Piedmont of North Carolina. In the southern coastal areas the wind and storm surge hit the Cape Fear River area, but inland flooding was not severe.



Locations of communities discussed in this report

Hurricanes Bertha and Fran. Hurricane Bertha was a Category 2 hurricane when it made landfall on July 12, 1996 (maximum sustained winds estimated to be 105 miles per hour). Severe storm induced erosion and storm surge significantly redefined the shoreline and protective dune system along much of the state's southeastern coast, particularly on Topsail Island.

Bertha also weakened the integrity of many structures which were not repaired before Fran hit 3 months later. Hurricane Fran made landfall near the mouth of the Cape Fear River on September 5, 1996. Fran was ranked as a Category 3 (major) hurricane on the Saffir-Simpson Scale. Bertha was more of a coastal storm than Fran. While the area included in the Bertha declaration was limited to 16 coastal counties, Fran's declared area extended far into the Piedmont region of the state and included four mountain counties.

Although Fran's destructive storm surge, waves and winds impacted the immediate coastal areas east and north of Cape Fear, heavy rainfall and high winds occurred well inland and resulted in riverine flooding and wind damage to residential and commercial buildings, manufactured homes, trees and crops and power distribution systems. Much of the wind-related damage was not caused directly by the wind but by wind-downed trees. In areas where soils were saturated by the heavy rainfall, many trees were unable to resist the high winds and caused extensive damage when they fell.

According to the National Hurricane Center it appears that Hurricane Fran may have reached design wind speeds (110 mph, fastest mile for a 50-year return frequency) in a small area along the shore. However, most coastal buildings in the study area received less than design wind speeds. Although the storm generated high winds along the coast and well inland, severe damage to buildings was concentrated in those areas affected by the storm surge and waves.

Rainfall exceeded five inches over an extensive area between September 3 and 12, 1996. This rainfall caused flood peaks exceeding the 100-year flood in several smaller rivers in the mountains. In the coastal areas, the only flooding on major rivers was an estimated 50- to 100-year flood on the Neuse River at Goldsboro and a 50-year flood on the Neuse River at Kinston. The flood peak on the Cape Fear River was a 5-year flood.

Hurricane Floyd. Hurricane Floyd made landfall near Cape Fear, North Carolina early on 16 September, 1999, as a category two hurricane with estimated maximum winds near 90 knots. Floyd was losing its eyewall structure as it made landfall on Oak Island and continued to push north-northeastward. Floyd's center passed over extreme eastern North Carolina on the morning of the 16th and over the greater Norfolk, Virginia area during the afternoon. Storm surge values as high as 9 to 10 feet were reported along the North Carolina coast.

Damage from Floyd was worse than might have been expected because of Hurricane Dennis which had dropped as much as eight inches of rain on eastern North Carolina just 10 days earlier. Also adding to the saturation problem was the fact that heavy rainfall preceded Floyd. Hence, even though Floyd was moving fairly quickly, precipitation amounts were very large. Rainfall totals as high as 15 to 20 inches were recorded in portions of eastern North Carolina and Virginia. At Wilmington, North Carolina, the storm total of 19.06 inches included a 24-hour record of 15.06 inches. In North Carolina, rivers rose as much as 23 feet above flood stage

Floyd was the deadliest hurricane in the United States since Agnes of 1972. There were 52 deaths that were directly attributable to Floyd in North Carolina. The storm damaged more than 55,000 homes, 17,000 were uninhabitable and another 7,000 were destroyed.

In the United States, the Property Claims Services Division of the Insurance Services Office reports that insured losses due to Floyd totaled 1.325 billion dollars. Total damage estimates range from 3 to over 6 billion dollars. Almost 20,000 small businesses incurred physical damage, 42,000 had their business disrupted and employers eliminated 31,000 jobs due to wind and flood damage.

Technical Approach

Project design. Upon receipt of the task order from FEMA, a project team was assembled by the Hazard Mitigation Technical Assistance Partnership, Inc., (HMTAPi). The Project Team included:

French Wetmore, Technical Manager (HMTAPi)
Berry Williams, Principal Investigator (HMTAPi)
Les Bond, Investigator (HMTAPi)

Gil Dunn is the ISO/CRS Specialist with the Insurance Services Office, Inc. for the state of North Carolina. He was consulted on many items and provided valuable background information and documentation. Concurrent with this project, he conducted routine verification visits in some of the communities affected, but coordination with him minimized confusion and work on the communities' part.

A Scoping Meeting was held on January 11, 2000, in Raleigh, the site of the Disaster Field Office, the State NFIP Coordinator and the ISO/CRS Specialist's office. The following were present in addition to the project team members:

Mark Vieira, Project Monitor (FEMA Region IV)
Bret Gates, Technical Monitor (FEMA HQ)
Mary Blocker, HMTAP Project Manager (FEMA Region IV)

The meeting decided on CRS activities to be evaluated, the communities to be visited, and the schedule of visits. The project team submitted a request for flood insurance and disaster assistance data on the communities under consideration for visits.

On January 20, the project team provided FEMA with the Initial Field Survey Report. This spelled out the details of the technical approach as settled at the Scoping Meeting. Each CRS activity was assigned to one of the HMTAPi team members. That person conducted most of the data collection, instructed others going to other communities on what would be needed, and did the analysis and report drafting for his activities.

The Initial Field Survey Report included a spreadsheet that matched communities with CRS activities and team member assignments. A simplified version of that spreadsheet is presented on the next page.

Field work. The team members conducted their field work during the months of January through April. The project timeline was delayed waiting for the appropriate data (in useable formats) from FEMA. Progress was reported to FEMA through e-mailed bi-weekly reports.

The details on the data collected are included in the discussion on each activity in the later sections of this report. Special survey or record forms were developed for several activities, which are included as appendices.

		CRS Activity								
Community	**County**	**300**	**410**	**420**	**430**	**520**	**530**	**610**	**630**	**CRS**
CRS Communities										
Belhaven	Beaufort	X					X			X
Whiteville	Columbus	X	X	X	X					X
Havelock	Craven	X								X
Wilson	Wilson	X		X	X					X
Oak Island	Brunswick				X					X
Lenoir County	Lenoir					X		X		X
Kinston	Lenoir		X	X		X				X
Wayne County	Wayne					X	X	X		X
Goldsboro	Wayne					X				X
Dare County	Dare						X			X
Non-CRS Communities										
Hertford	Perquimans	X								
Elizabeth City	Pasquotank	X								
Blandenbord/Clarkton	Bladen	X								
Rocky Mount	Nash	X								
Severn	Northampton		X		X					
Other Counties								X	X	

CRS Activities planned for evaluation

300 – Public Information activities (320 – 360)
410 – Additional Map Data
420 – Open Space Preservation
430 – Higher Regulatory Standards
520 – Acquisition and Relocation
530 – Retrofitting
610 – Flood Warning Program
630 – Dam Safety

The last column identifies communities selected for an overall evaluation of the CRS.

Interviews. The data collection effort included two sets of interviews. A subcontractor, Human Technology, Inc., called floodplain residents in five communities and asked questions that focused on their level of knowledge and the effectiveness of local public information programs. The results are covered in the section on the 300-series.

Project team members interviewed the CRS Coordinators in nine of the ten CRS communities. The questions addressed local public information activities and the impact of the CRS in general. The latter is discussed in the last section of this report.

Activities not evaluated. As with the post-Fran CRS evaluation, the project team found several cases where there were inadequate data or inappropriate situations for the evaluation. We were unable to evaluate the following items that are marked with an "X" in the above spreadsheet.

300 Series: This series of public information activities was evaluated through telephone interviews of floodplain residents. We were unable to get anyone to answer their phones, return calls or agree to the interviews in Whiteville or Wilson. We were unable to obtain

enough telephone numbers for floodplain residences in Hertford, Blandenbord, or Clarkton. However, we substituted two other non-CRS communities for these.

410: The areas credited for additional flood data in Whiteville and Kinston either did not get flooded by Hurricane Floyd or had no new buildings constructed in them since the data went into effect. Therefore, only Severn had an adequate base for an evaluation of this activity.

420: The open space areas flooded in Kinston were the same areas that were evaluated after Hurricane Fran. Since then, the adjacent areas have been acquired and cleared. We had no comparable developed area to compare the "with" and "without" open space conditions with damage-prone areas. Besides, we had already shown the benefits of preserving open space at those sites. Therefore, we dropped Kinston as a 420 site.

Whiteville was receiving the "default" credit for this activity for a small open space area. We replaced Kinston and Whiteville with Rocky Mount to get a larger sample and more meaningful conclusions.

430: Talking to the local officials in Wilson revealed that there had been no opportunity to enforce their cumulative substantial improvement (CSI) regulation since it was passed. Therefore, we dropped this element from the evaluation.

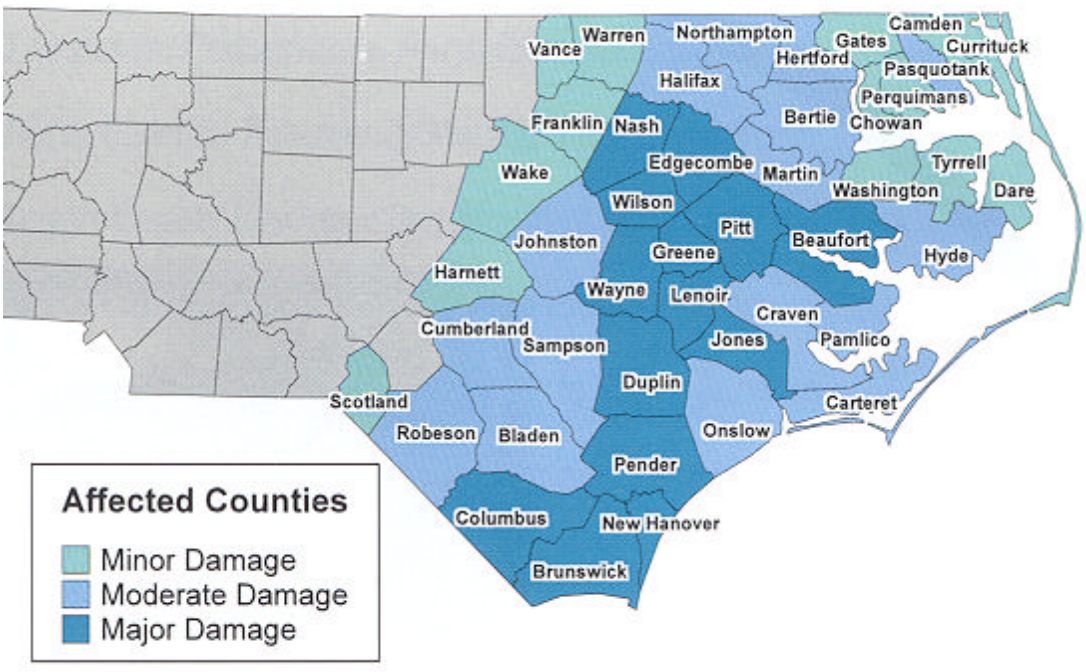
Wilson was also slated for evaluation of its freeboard standard. However, it enacted its two foot freeboard requirement when it joined the Regular Program in 1982. There were no non-freeboard buildings to compare with those benefiting from freeboard. An evaluation comparing buildings with freeboard to pre-FIRM buildings was prepared, but is not included in this report, because it does not evaluate the benefit of a CRS credited activity versus meeting the minimum requirements of the NFIP.

Similarly, Whiteville had had only two new buildings constructed since its freeboard (FRB) requirement went into effect. We were able to talk to local officials and use flood insurance claims data to evaluate freeboard in Goldsboro and Wayne and Dare Counties, instead.

520: Four communities' acquisition programs were to be evaluated. None of them had received CRS credit for this activity. They were selected because they were slated for acquisition projects following Hurricane Fran. As it turned out, two of them, Goldsboro and Lenoir County had not actually cleared any properties before Hurricane Floyd.

The project team was unable to collect the data from a third, Kinston. We were able to look at 23 sites that had been purchased and cleared in Wayne County before Floyd hit.

530: As with 520, Wayne County does not receive CRS credit for retrofitting buildings. It was selected for this evaluation because it had applied for mitigation funding of many building elevation projects. However, the project team found out later that the County changed its request to acquire all of the buildings slated for retrofitting.



Map showing the 14 counties hit hardest by Hurricane Floyd
Source: *Hazard Mitigation in North Carolina: Measuring Success*, North Carolina Emergency Management Division, 2000.

610/630: The project expected to collect data on flood and dam failure response plans, credited under CRS activities 610 and 630. Team members talked to the emergency managers for 12 of the 14 hardest hit counties. They found that none of the emergency managers had flood-specific disaster response plans. None of them had dam failure response plans and many claimed not to have any dams in their counties (even though several of them had dam failures).

Given the lack of programs to evaluate, these two activities were dropped entirely. However, the questionnaire forms were reviewed. The revised versions are included as Appendices D and E.

Overall CRS: We were able to conduct interviews with nine of the ten communities' local officials. Kinston's would not return calls after the initial visit.

300 Series – Public Information Activities

Background

Telephone survey. To determine the effectiveness of several of the public information activities credited by the CRS, a telephone survey was conducted in May, 2000. We wanted to interview people who had received the most intensive of the CRS credited outreach projects – mailings to floodplain residents that told them clearly that they are exposed to flooding and offered suggestions on what they could do to protect themselves.

The survey was complicated by several factors. First, we needed telephone numbers of floodplain residents in CRS and non-CRS communities. We obtained over 800 addresses in 10 communities. The CRS communities provided their mailing addresses. Because there were no GIS-based address lists available, the rest were obtained through field visits to the mapped floodplains.

The project was subcontracted to Human Technology, Inc. (HTI), a Virginia-based contractor with previous experience in both CRS evaluation and telephone interviews. HTI was able to match most of the addresses to telephone numbers. Of the 810 addresses provided, their search generated 464 valid phone numbers.

However, they found that in some communities, many of the numbers were of businesses. For example, the addresses for Lake Waccamaw and Hertford only produced phone numbers from commercial properties, probably because the floodplain is mostly within the business district. These were thrown out because our work was to focus on residents.

HTI also found that many of the homes were unoccupied as the residents were waiting to sell their flooded and unrepaired properties to the government. In some cases, residents did not want to do the survey because they "didn't want to have to rekindle things from the past."

Survey numbers. HTI was able to make phone calls to 464 properties with what appeared to be valid residential phone numbers. All numbers were called five times. Here are the results of the call attempts:

Phone call results	Number
Completed Calls	204
Disconnected during the questioning	50
Terminated during the interview	42
Refusal before or during the interview	73
Business/government number	9
Busy/no answer/answering machine	86
Total	464

With five calls made to 464 homes between 6:00 and 8:00 in the evenings, a total of 359 people were reached. However, there were only 204 completed interviews. These came from two CRS communities and three non-CRS communities.

Community	Population	Respondents	Flood problem **
CRS Communities			
Belhaven	2,261	116	1
Havelock	20,047	7	5
		123	
Non-CRS Communities			
Elizabeth City	14,566	35	4
Rocky Mount	50,383	16	2
Washington *	9,139	30	3
		81	

* Washington is a CRS community, but it does not have any outreach projects.

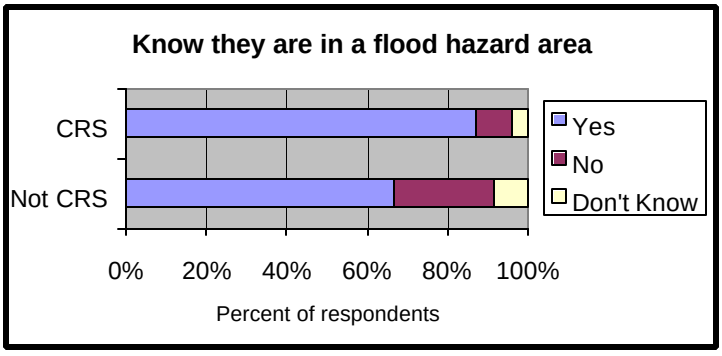
** This column is a subjective ranking of the relative severity of the communities' flood problems. Belhaven is 100% in the mapped Special Flood Hazard Area while Havelock has only 20 SFHA properties due to its subdivision design policies. Washington has a levee that protects it from smaller floods.

This section summarizes the results of the 204 interviews. The data are by CRS and non-CRS community to determine if the CRS-credited activities produced different results. It should be noted that, due to the numbers, this evaluation is really comparing Belhaven's program against three non-CRS communities. Belhaven is in a unique situation, being 100% floodprone and having been flooded four times since 1996 by Hurricanes Bertha, Fran, Dennis and Floyd.

Coordinator interviews. Project team members were able to interview the CRS Coordinators in nine of the ten CRS communities. They completed a questionnaire form which had four questions on the impact of the 300-series of public information activities. The results are reported separately later in this section.

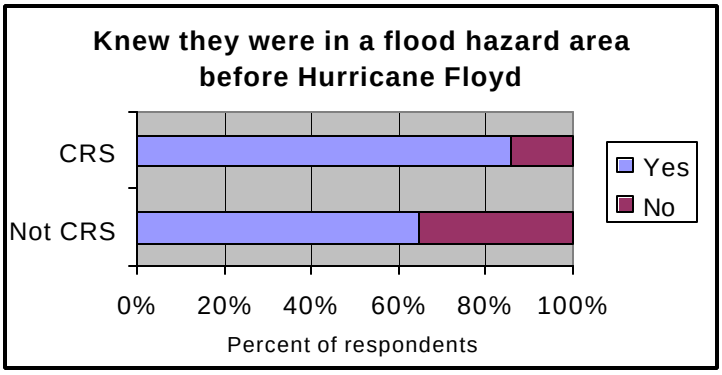
Knowledge of Exposure to Flooding

Knowledge of exposure. One of the first questions asked was, "Do you know if your property is in a flood hazard area?" The summary of the results is shown on the right. The raw data are shown in the table on the next page.



Know they are in a flood hazard area								
	Yes		No		Don't Know		Total	
CRS	107	87%	11	9%	5	4%	123	100%
Not CRS	54	67%	20	25%	7	9%	81	101%
Total	161		31		12		204	

The respondents who said "yes" to this question were then asked, "Before Hurricane Floyd hit last September, did you know that your property was in a flood hazard area?" The summary of the results is shown on the right. The raw data are shown in the table below.



Knew they were in a flood hazard area before Floyd						
	Yes		No		Total	
CRS	92	86%	15	14%	107	100%
Not CRS	35	65%	19	35%	54	100%
Total	127		34		161	

The results showed that the residents in the two CRS communities were more aware that they lived in a flood hazard area than did the residents in the non-CRS communities.

Where did they learn it? The next question is "Why were they more aware?" The 127 residents who knew they were floodprone before Hurricane Floyd were asked "How did you find out that your property was in the flood hazard area?"

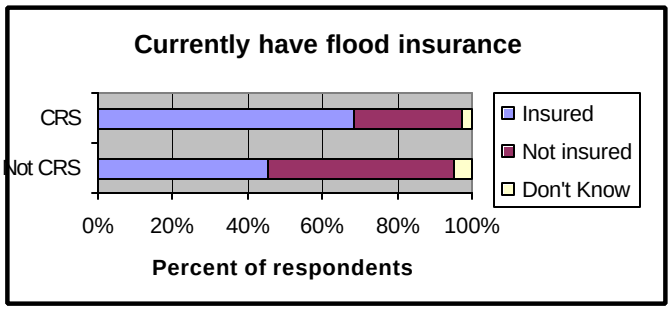
How they found out about flood hazard	CRS		Non-CRS		Total	
Asked local official	3	3%	1	3%	4	3%
Unsolicited advice from community official	1	1%	1	3%	2	2%
Newsletter or flyer from community	6	7%	1	3%	7	6%
Lender/appraiser	3	3%	8	23%	11	9%
Real estate agent	4	4%	5	14%	9	7%
Insurance agent	1	1%	5	14%	6	5%
Previous owner	3	3%	1	3%	4	3%
Neighbor/friend's advice	5	5%	1	3%	6	5%
Figured it out by myself	31	34%	3	9%	34	27%
Had seen previous floods	27	30%	2	6%	29	23%
Flood map	1	1%	3	9%	4	3%
Had property surveyed	0	0%	2	6%	2	2%
Other responses	4	4%	0	0%	4	3%
Don't Know/Refused	2	2%	2	6%	4	3%
Total	91	100%	35	100%	126	100%

The first three responses relate to community provided services that are credited by the CRS. While the CRS communities have the edge here, the numbers are too small to make any solid conclusions.

All of the CRS community responses for "Figured it out by myself" and "Had seen previous floods" were from Belhaven. Apparently the community's flood hazard is common knowledge. Given this and the wide distribution of the other responses, no conclusions were drawn from this question.

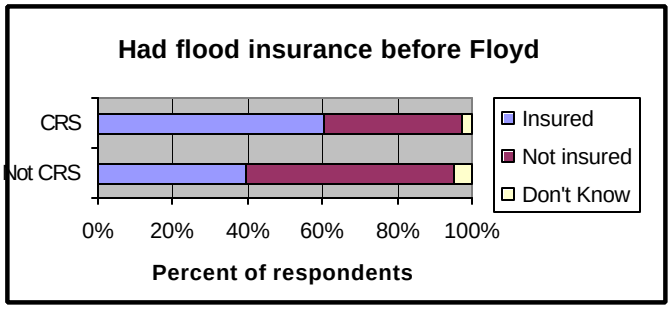
Flood Insurance

Insurance coverage. All respondents were asked, "Do you currently have flood insurance on your property?" The results are similar to the question on awareness of the flood hazard.



	Are Insured		Not Insured		Don't know		Total	
CRS	84	68%	36	29%	3	2%	123	99%
Not CRS	37	46%	40	49%	4	5%	81	100%

All respondents were also asked "Before Hurricane Floyd hit last September, did you have flood insurance on your property?" There is a similar higher level of coverage in the CRS communities:



	Were Insured		Not Insured		Don't know		Total	
CRS	74	60%	46	37%	3	2%	123	99%
Not CRS	32	40%	45	56%	4	5%	81	101%

Where did they learn about it? As with awareness, we wanted to know "Where did you get the idea or information to buy flood insurance?" Because many property owners have been required to purchase flood insurance as a condition of disaster assistance, this was asked of only those who were insured *before* the hurricane. The results are displayed in the table on the next page.

How they found out about insurance	CRS		Non-CRS		Total	
Asked local official	1	1%	1	3%	2	2%
Unsolicited advice from community official	0	0%	0	0%	0	0%
Newsletter or flyer from community	3	4%	0	0%	3	3%
Lender/disaster assistance	21	28%	16	50%	37	35%
Real estate agent	7	9%	7	22%	14	13%
Insurance agent	9	12%	1	3%	10	9%
Previous owner	3	4%	0	0%	3	3%
Neighbor/friend's advice	7	9%	3	9%	10	9%
Figured it out by myself	14	19%	2	6%	16	15%
Had flooded previously	4	5%	0	0%	4	4%
NFIP Advertising	2	3%	0	0%	2	2%
Other responses	3	4%	0	0%	3	3%
Don't Know/Refused	0	0%	2	6%	2	2%
Total	74	100%	32	100%	106	100%

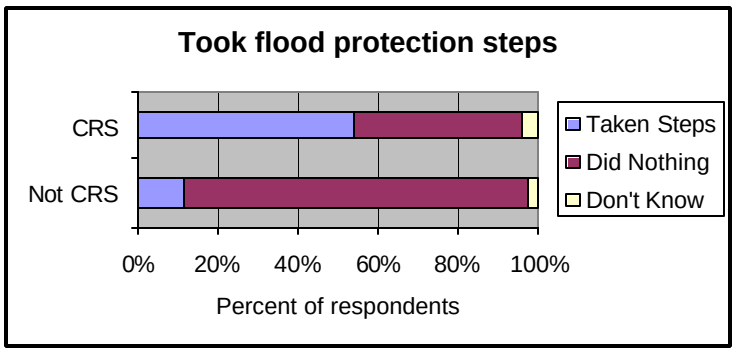
Not surprisingly, the single most important source of information on buying flood insurance was the lender (including federal agencies that administer disaster assistance programs).

It appears that the community's program was not felt or remembered to be important. As with the flood awareness question, given the wide distribution of the other responses, no other conclusions were drawn from this question.

Flood Protection Measures

Taken measures? One objective of the CRS-credited public information activities is to encourage residents to implement retrofitting and similar flood protection measures in addition to the purchase of flood insurance.

All respondents were asked, "Before Hurricane Floyd hit last September, had you taken any steps to protect your property from flood damage?" The results show a much greater difference between the CRS and non-CRS communities than the previous questions.



	Did something		No		Don't know		Total	
CRS	66	54%	52	42%	5	4%	123	100%
Not CRS	9	11%	69	85%	2	3%	81	99%

What was done. The respondents who had done something were asked "What had you done to protect your property?" Because there were so few non-CRS respondents, a comparison between the two types of communities was not done and percentages are not included in the table below.

Property protection measure	CRS	Non-CRS
Elevated all or parts of the building above flood	34	2
Elevated furnace, water heater, air conditioner, etc.	19	1
Regraded yard or redirected drainage	1	2
Waterproofed or floodproofed walls	4	
Moved damageable contents	24	3
Secured loose objects in the yard	15	1
Fixed sewer problem	1	
Decided to not make improvements in floodprone areas	1	1
Other responses	14	1
Don't Know/Refused	1	1

Note that 28 CRS and 2 non-CRS respondents listed more than one measure, so the total number of measures taken is greater than the number of respondents. In addition to listing what they had done, several noted that they were on a waiting list for an acquisition or elevation project.

Where did they learn about it? The next question posed was, "Where did you get the idea or information to do what you did?" The answers appear below.

How they learned about property protection	CRS	Non-CRS
Asked local official	1	
Unsolicited advice from community official	2	
Newsletter or flyer from community	6	1
Lender		
Real estate agent	1	
Insurance agent	1	1
Previous owner	3	1
Neighbor/friend's advice	5	2
Figured it out by myself	29	3
Researched it/looked in library	1	
Had flooded previously	5	
Project funded by FEMA	6	
Television	2	1
Local regulatory mandate	1	
Other responses	3	
Don't Know/Refused		
Total	66	9

Due to the small number of non-CRS respondents who had taken property protection measures, the effectiveness of a CRS program cannot be compared. One revealing conclusion is that funding and mandates accounted for very little compared to information activities and "figured it out by myself."

Dare County, Village of Avon

Activity 360 (Flood Protection Assistance) can be the most intensive public information effort. To receive many of the possible points, local staff must offer advice and guidance to property owners interested in protecting their homes or businesses from flood damage. This one-on-one assistance is considered to be the most effective method of encouraging people to retrofit, short of a regulatory mandate or financial assistance.

The unincorporated village of Avon is located at the southern end of Hatteras Island in Dare County. Many of the homes in the older portion of the Village were built in the late 1800's and early 1900's long before the NFIP. Flooding from eight hurricanes between 1954 and 1998 repeatedly damaged Dare County. Between 1985 and 1993 many of these older homes had floodwater inside the structures two or three times.

This frequency of flooding encouraged several homeowners in the Village to pay for elevating their homes without State or Federal assistance. They were encouraged and assisted in this effort by Dare County. The building inspector on Hatteras Island provided technical assistance to the homeowners. This included providing information on retrofit methods and site visits to help homeowners evaluate their options. The inspector also provided information on the condition of the building, names of contractors, potential costs and steps required to complete the project.

Dare County also encouraged the retrofit by not factoring the elevation of the structure into its tax assessment. Elevating a home reduces its risk of flooding and, in principle, increases the value of the home. Dare County's method of assessment does not incorporate this increase into the assessed tax value; thus homeowners do not feel penalized by the tax code for making the improvement.

More than forty homes on Hatteras Island have been elevated in the past five years, all without the benefit of state or federal grants. The average cost associated with the retrofit projects was about $14,000 for a pile foundation and approximately $11,000 for elevation on a wall foundation (1993 dollars).

Most of the property owners who elevated their homes had flood insurance. Many used part of their flood insurance claim payments and additional bank loans to finance the elevation of their structures. The building inspector helped the property owners identify their flood insurance premium cost saving. This helped them see how long it would take to pay for the improvements with the reduced insurance premium. Generally, the payback period was 10-20 years. But according to the property owners, the biggest benefit is peace of mind.

The dollar benefits of this mitigation approach are detailed in the section on Activity 530 (Retrofitting) on pages 49 – 50.

CRS Coordinators' Opinions

Nine communities' CRS Coordinators were interviewed about their views of the effectiveness of the 300-series of public information activities. The data on all these questions are displayed together in the table below.

Activities implemented. All nine communities provide map information (320) and most of them have provided flood protection references to their public libraries (350) . All of the cities do some form of outreach projects (330) and site visits or other retrofitting advice (360) . Except for Dare County (on the coast), the counties are not as active.

Effectiveness of the activities. The interview asked three questions focused on whether the local official felt the activities were effective. When asked "Which, if any, of these activities are effective in telling people" about different subjects, they identified some, but not all, of the ones they were doing. There was no consistent answer, other than 320 (Map Information) which they were all doing.

CRS Coordinators' Interviews			Belhaven	Goldsboro	Havelock	Oak Island	Whiteville	Wilson	Dare County	Lenoir County	Wayne County
Approximate number of buildings in SFHA			All	400	28	210	100	400	850	700	700
Activity/Element		Description									
320	MI	Map Information	X	X	X	X	X	X	X	X	X
330	OPC	Outreach projects to community				X					
	OPF	Outreach projects to floodplain	X		X		X	X	X		
	OPA1	Brochures/telephone book		X	X		X				
	OPA2	Presentations at meetings							X		X
340	DFH	Real estate disclosure				X		X			
350	LIB	Flood protection library	X	X	X	X	X	X	X		X
360	FPA1	Advice on retrofitting buildings	X	X	X		X		X		
	FPA2	Site visits	X	X	X	X	X	X	X		
Which, if any, are effective in telling people											
About the hazard they are exposed to?			OPF	320	320	320 OPC DFH LIB	320 330	320 DFH	320 OPF 360	320	320
How to protect themselves from damage?			OPF	320		320 OPC DFH	360	330 LIB 360	360		360
About flood insurance?			OPF	320	320	320 OPC	320 330	320 330	320 OPF 360	320	
Are any of these activities a waste of money?			No	No	No	—	No	OPF	No	No	—
Any projects been done because of them?			Yes	No	No	No	No	No	Yes	No	No

To the question, "Do you think any of these activities are a waste of time or money?" only one community answered in the affirmative (two did not answer). Both of the respondents in Wilson noted that OPF was initiated only to get enough CRS points for a Class 9. They were considering dropping this element.

The CRS Coordinators were also asked, "Do you know of any instances where someone installed or implemented a flood protection measure, such as retrofitting or drainage improvements, because of the information or technical assistance provided under one or more these activities?" Belhaven and Dare County responded, "Yes." Dare County's program is described in more detail in Activity 530 (Retrofitting).

Wilson, Lenoir County and Wayne County said that they have seen retrofitting projects, but that they could not directly attribute them to local public information activities. They think that the flood and hazard mitigation grants played a larger role. Belhaven's response indicated that these factors were important there, too.

Conclusions

Data problems. There are several shortcomings with the data collected by the telephone survey:

- There was a relatively small number of successful interviews.
- The respondents from Belhaven comprise 94% of the responses from CRS communities, skewing the results to the activities of only one community which has an above average flood problem.
- There were several indications that some respondents did not understand some questions (e.g., they stated that they had retrofitted before Floyd, but said later that their measure was not effective because it had not been funded yet (discussed under retrofitting on pages 51 – 52).
- The interviews took place more than eight months after the flood. It can be surmised that many respondents had trouble differentiating between what they knew before Hurricane Floyd and what they knew afterward.
- The fact that many of these communities (and perhaps many of the properties owned by the respondents) were flooded by Hurricane Fran in 1997 is probably significant in both awareness of flooding and actions taken by owners.

Impact of CRS activities. Residents of CRS communities:

- Had a higher level of awareness that they were exposed to a flood hazard,
- Had a higher level of flood insurance coverage, and
- Had implemented more flood protection measures.

– However, when asked where they got the information for these things, we found no significant impact due to community-run public information programs.

– The local officials who implement the public information activities said they are effective in informing people and, with only one exception, believed they are worth the effort. However, only two felt they could tie their information and assistance activities to actual retrofitting or other projects on the ground.

General conclusion on the survey results. The following quote is from the Human Technology, Inc., survey project manager and summarizes well what we can conclude from the survey. The "report does indicate that the public awareness is there but where residents learned about activities is still questionable. I don't think that this questionnaire/evaluation can rule out that CRS did or did not impact the awareness level, given your goal of the questionnaire, to determine the impact of the public information activities - the question seems to be answered that there is awareness….The next question is whether it is enough that there is awareness or is it important to find out more about where that awareness is learned?"

400 Series – Mapping and Regulations

Background

The 400 series include five activities, of which three were selected for evaluation:

410 – Additional Flood Data
420 – Open Space Preservation
430 – Higher Regulatory Standards

Protecting new and existing development from flood hazards requires the combination of accurate floodplain mapping and related flood data. While they are credited as different activities, they complement each other. It is difficult to separate them and their impacts.

Even though its is not a CRS community, actions undertaken by the Town of Severn provide a good example of how combining mapping and other methods of mitigation worked to reduce flood losses during Hurricane Floyd. Severn turned out to be the only community where Activity 410 (Additional Flood Data) could be evaluated. It is easier to present the impact of the 400 series by viewing the combined effect from the community perspective rather than divide the impact into separate activities.

410 & 430 – Severn

The setting. Severn is a peanut-processing center 3 miles south of the Virginia State line (see map, page 3). It has a population of 306, many of whom are elderly. Kirby Creek, a tributary of the Meherrin River and an unnamed tributary bisect Severn.

On the evening of July 4, 1995, a thunderstorm stalled over the Kirby Creek watershed. An unofficial rain gage in Town measured over 8 inches in four hours, with more than 4 inches in 55 minutes. Fifteen homes in Severn, two homes in the County just outside of Severn, the Town Hall, two businesses and the sewer lift station were flooded. Damage was moderate to severe with some of the homes being total losses.

The Flood Insurance Rate Map for Severn is a Flood Hazard Boundary Map dated November 3, 1978, which was converted to a FIRM by letter effective February 1, 1987. Kirby Creek is delineated as an unnumbered A zone on that map. The watershed area, as delineated on the USGS Quadrangle map, is 1,751 acres or 2.74 square miles. The unnamed tributary is not shown on the FIRM.

The 1995 flood was caused by heavy local rainfall and worsened by a debris problem at the culverts under State Highway 35. A storage shed almost entirely plugged one of the two 6′ x 8′ box culverts. Water backed up in the residential portion of the floodplain until it overtopped State Highway 35. Floodwater was as high as 4 to 5 feet deep in some homes.

As a result of the severity of the flood, Town officials recognized that rebuilding should not take place until flood risks were better delineated. Since the FIRM did not identify base flood elevations, the Town asked the state to prepare a detailed study with flood elevations to be used in their construction regulations. At the same time, the Town adopted a moratorium on the repair of damaged buildings and requested a disaster declaration from the Governor.

The flood study. The State NFIP Coordinator, the North Carolina Department of Transportation (NCDOT) and the U.S. Army Corps of Engineers (Corps) organized a joint study effort. Each agency sent team members to Severn. The NCDOT provided a survey crew to survey cross sections of Kirby Creek and its tributary. The Corps identified areas to be surveyed and produced flood profiles for the streams.

The hydrologic analyses prepared by the Corps found that the estimated 6.0 inches of rainfall in the peak hour significantly exceeds (by approximately 43%) the estimated 500-year rainfall value (of approximately 4.2 inches) for the Severn area. In addition, the total storm precipitation of approximately 8.25 inches over an estimated three-hour period exceeds the 500-year rainfall value by approximately 30%. The Corps concluded that the flooding that occurred in Severn on July 4 – 5, 1995 exceeded the 500-year flood level.

The hydraulic characteristics of flooding along the lower portion of Kirby Creek and the concrete channel tributary were analyzed to provide estimates of the elevations of the 10-, 25-, 50-, 100-, and 500-year floods. Cross sections were located at close intervals to culverts in order to compute the backwater effect of those structures. As a result, the Corps estimated the elevation of the 100-year flood to range from 56.3′ to 56.8′ M.S.L. They estimated the 500-year flood level to range from 59.2′ to 59.4′ M.S.L.

The regulations. Using this information the Town of Severn adopted a revised floodplain management ordinance with the Corps floodplain map. All new buildings are required to be elevated to 59’ M.S.L., slightly more than two feet above the 100-year flood elevation, and less than 0.5’ below the 500-year flood elevation. This results in an effective regulation for two feet of freeboard, which would be credited under Activity 430.

Recovery and Mitigation. To assist with the recovery, the Governor declared Severn to be a disaster area and set aside $600,000 in Community Development Block Grant (CDBG) “urgent needs funds.” The American Red Cross, the regional community action agency, and local churches organized to help families with temporary housing, clothing, contents, medical and transportation needs.

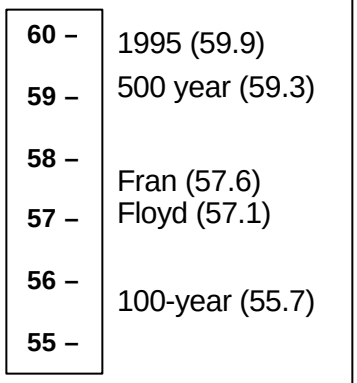
The CDBG grant was used to rehab and elevate two houses, replace four residences with manufactured housing units and demolish and clear one house from the floodplain. All of these residences were elevated to 59′ M.S.L., more than two feet above the 100-year flood elevation. These structures are as much as 42” higher than those that were in existence prior to the 1995 flood.

Severn's building official showing the 1995 flood depth on a residence that was later replaced.

Four of the flooded buildings in Severn were replaced by elevated manufactured homes like this one.

Six other houses were repaired but not elevated since their lowest floors already exceeded the regulatory flood elevation or were located outside the new regulatory floodplain. The Town Hall was moved to another building across the street, which is also above 59' M.S.L. A 1.2-acre parcel in the residential area was purchased by the Town to provide access to the drainage channel for maintenance and to prevent floodplain development.

Flood damage. During Hurricane Fran in 1997, the flood elevation reached 57.6' M.S.L. (1.1 feet over the 100-year flood elevation) at South Street. At this same location during Floyd in 1999, the water reached an elevation near 57.11' M.S.L. (1.4 feet over the 100-year flood elevation). Floodplain mapping, elevating and relocating structures, and the adoption of a two-foot freeboard limited flood damage to wet insulation under the floors of the structures. Each of these homes would have been flooded with over a foot of water had they not been elevated using the new study's flood elevation and the higher regulatory standard.



Flood depths at South Street in Severn

Although floodwater did not enter the six buildings elevated as part of the CDBG project, NFIP flood insurance claims for three of the structures totaled $4,232. These losses, even for elevated structures, are typical due to the construction practices in this area. Structures elevated on crawlspaces generally include improvements under the structure (i.e. ductwork and insulation) that may be damaged. No flood insurance policies were found for three other homes. These six homes which were elevated and repaired in 1995 would have been flooded one to three feet deep during Hurricanes Fran and Floyd had they not been elevated.

Dollar savings. Six houses were elevated two-feet above the base flood elevation as part of the recovery project. Two additional houses in the SFHA, represented by "G" and "H" in the table below were repaired but not elevated. Their lowest floors are 1.2 and 2.1 feet above BFE respectively. House "G" was not elevated an additional .8 of a foot to meet

the new two-foot freeboard because it was not substantially damaged and elevation was not cost -effective.

To estimate the benefit of the elevation project, FEMA's Riverine Flood Benefit-Cost Module was used to perform a benefit-cost analysis for the six elevated structures. The results are in the table, below.

Damage Avoided in Severn					
Structure Identification	Before Mitigation		With Mitigation		NFIP Claim
	Flood Depth	Loss Expected	Flood Depth	Loss Expected	
A	2'.6"	$29,664	-1	$1,440	
B	1'.0"	4,950	-1	1,280	
C	1'.2"	7,112	-1	1,650	$1,630
D	1'.1"	4,950	-1	1,280	
E	1'.6"	21,436	-1	1,150	
F	2'.2"	39,356	-1	1,650	
	Subtotal	$107,468		$8,450	$1,630
Additional Structures Originally Constructed with Freeboard					
G			-1	1,650	1,962
H			-1	1,920	2,895
	Total:			$12,020	$6,487
	Average Loss	$17,911		$1,503	$ 2,162

According to these data, the estimated damage expected during Hurricane Floyd without the buildings being elevated totaled $107,468. With the elevation the expected flood losses were reduced to $8,450. Thus, a savings of almost $100,000 in this single event.

An attempt was made to check the estimated loss with NFIP insurance claims. Only one flood insurance policy and claim file could be identified for the six elevated buildings. While there is a close match of the "loss expected" produced by the model and the NFIP claim, one match does not provide enough data to draw conclusions about the use of the benefit-cost model.

The two additional houses elevated at the time of their initial construction are also covered by flood insurance. A comparison of the "loss expected" and the NFIP claims for these structures shows a wider difference in these values. However, the data collected for this project cannot explain the differences between the depth/damage curve estimates and the NFIP claims data for the elevated buildings.

On the other hand the reduction in flood losses is attributable to the combination of floodplain mapping and the adoption of a two-foot freeboard requirement. Without the mapping and elevation requirement the structures could have been placed near grade, resulting in higher losses during both Hurricanes Fran and Floyd. Thus, in three short years during two hurricanes, the project has saved approximately $200,000 in flood losses to these structures. The floodplain map and flood data helped provide additional savings as reported in the section on Retrofitting, page 43.

420 – Open Space Preservation

Open space preservation is recognized in the CRS as perhaps the best way to prevent flood damage. Credit is provided to a community if a portion of its floodplain is currently undeveloped, and if through ownership or deed restrictions, the community can demonstrate that it will remain free of buildings and fill. Two CRS communities are included in this analysis: Rocky Mount and Wilson.

Activity Impact Measures. The flood loss reduction impact of preserving open space is measured by comparing the damage to open space areas to the damage to adjacent floodplain areas which were developed.

Rocky Mount

Rocky Mount is a growing city in northeastern North Carolina. The main flood threat in the City is the Tar River and several of its tributaries. The U.S. Geological Survey (USGS) estimates that the peak flow on the Tar River at Rocky Mount during Hurricane Floyd was 34,100 cfs. The USGS currently estimates the 100-year flow at that point at 27,700 cfs and the 500-year flow at 35,500 cfs.

The maximum stage at Rocky Mount during Hurricane Floyd was 85.5 feet. The 100-year flood elevation on the 1982 Flood Insurance Rate Map at that location is about 82.3 feet, or 3.2 feet lower than the flood during Hurricane Floyd. The USGS currently estimates the 100-year flood elevation at 83.9 feet, 1.6 feet higher than the 1982 Base Flood Elevation. (As a result of Hurricane Floyd, the City is working with the State of North Carolina and FEMA to purchase several hundred buildings, primarily single family dwellings.)

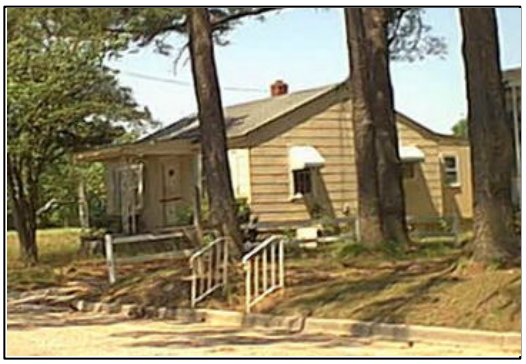
The parks. The City currently has credit for Activity 420 based on a default value for the impact adjustment ratio (rOS). For this credit it must only document that there are at least 5 acres of floodplain preserved as open space. The three parks used for this project are:

Park	Area (Acres)	Floodplain (Acres)
Battle Park	56.5	28.0
Sunset Park	38.4	38.4
City Lake Park	20.0	20.0

The damage to all City parks (350.6 acres) totaled $7.38 million, of which $6.15 million was damage to buildings and their contents which are not appropriate open space uses. The buildings are not being repaired, and the City plans to relocate their uses outside the floodplain. Another $0.94 million damage was done to swimming pools in Sunset Park. The total damage to City parks was about $21,000 per acre. If the damage to buildings and their contents are not included, the damage was about $2,850 per acre.

Battle Park. An area across the Tar River from Battle Park was severely flooded. The City is acquiring 24 single family residences in this area. The City used FEMA's Residential Substantial Damage Estimator program (RSDE) to estimate the average replacement cost for these homes at $51,039. The average estimated damage to each home was $40,938. Although it is estimated that the average lot size is about 17,500 square feet (0.40 acres), about half of the lots were empty when Hurricane Floyd occurred. Therefore, these 24 residences were located on about 18.9 acres. The total damage to these homes was $982,515, or $51,985 per acre. If the area had been fully developed with similar buildings, the damage would have averaged over $102,000 per acre.

A bicycle/pedestrian path in Battle Park



A typical home near Battle Park

Fourteen residences in this area had NFIP flood insurance claims. The average damage to these buildings was $42,046 and the average replacement cost, according to the insurance claims, was $66,185. Using this damage figure as an average for all 224 residences in the area, the damage per acre was $53,391. If the area had been fully developed, the damage would have been about $104,560 per acre.

Sunset Park. An area adjacent to Sunset Park was severely flooded. As a result, the City is buying out 90 single family residences, two duplexes, a six-unit apartment building and a 148-unit apartment complex. These properties were located on about 48.2 acres and suffered an estimated $4,736,461 in damage (RSDE). The replacement cost for these buildings is estimated at $5,857,622. The damage in this area is estimated at almost $98,300 per acre.

Part of Sunset Park

A residence across from Sunset Park

There were no insurance claims on the duplexes or the apartment buildings. The flood insurance claims for 50 residences in the area averaged $57,578. Applying these damage figures to all 90 single family residences gives an estimated total of $5,182,020. This is somewhat higher than the estimate from the RSDE, and results in damage of over $107,500 per acre for the area adjacent to Sunset Park.

City Lake Park. In an area adjacent to City Lake Park (Lafayette Circle), 12 single family residences suffered $1,131,810 as estimated by the RSDE. These were large residences on large lots covering about 8.6 acres. The damage in this area is estimated at about $131,600 per acre.

City Lake Park

Residence on Lafayette Circle

Six of the residences near City Lake Park had average flood insurance claims of almost $245,000. For these six buildings, there is a large discrepancy between the RSDE estimates and the NFIP data for both replacement cost and damage. As shown in the table below, the difference between the estimated replacement cost using the two methods is 89%. The difference in estimated damage is 145%. These differences were not seen in the other two samples in Rocky Mount. Using the average NFIP claim for the twelve buildings, the damage per acre for the area adjacent to City Lake Park is about $140,000.

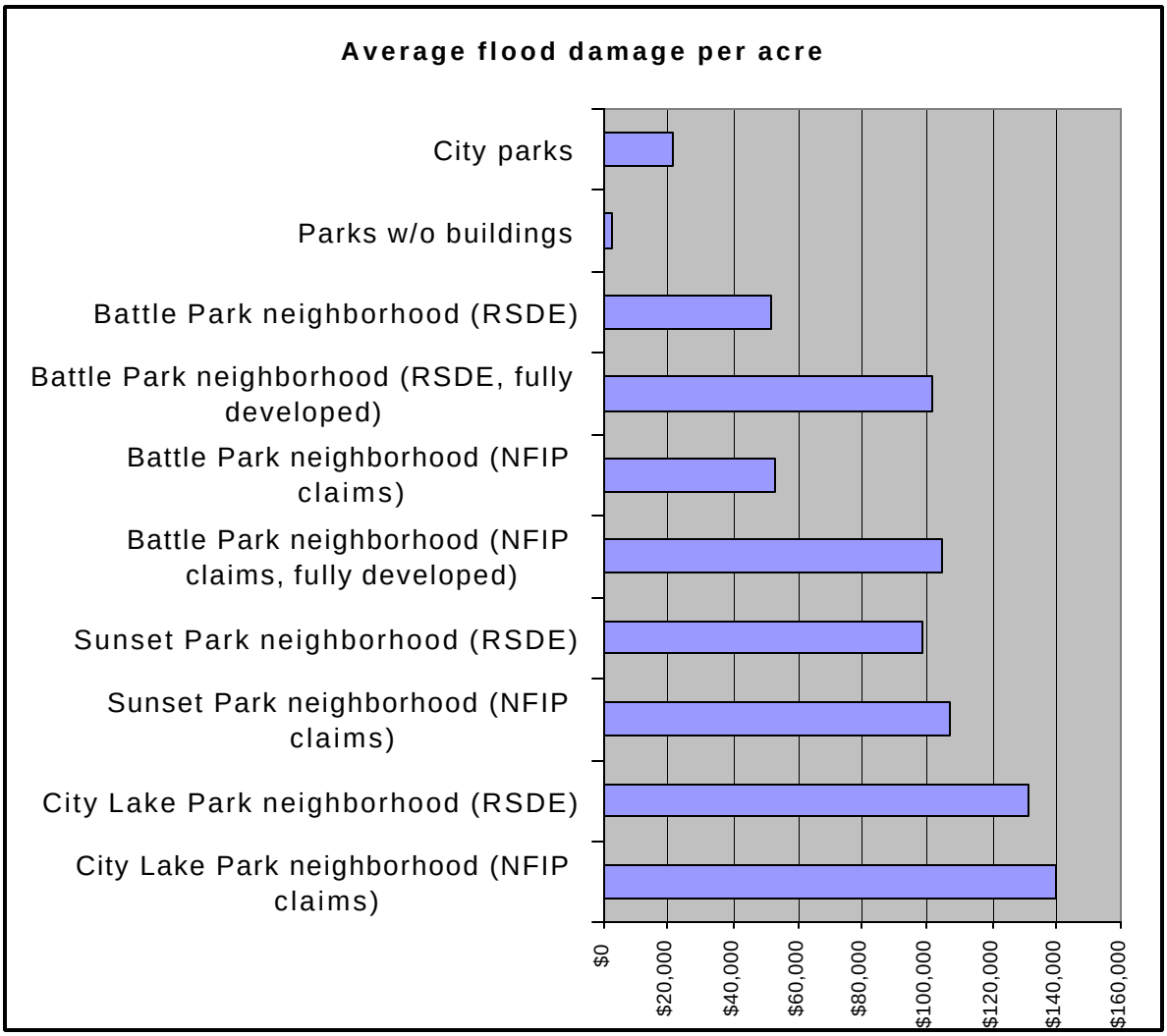
Comparison of two estimates of damage and replacement costs (City Lake Park)						
Building ID	Replacement cost		Dollar damage		Percent damage	
	RSDE	NFIP	RSDE	NFIP	RSDE	NFIP
A	$148,665	$90,573	$148,665	$57,595	100.0%	63.6%
B	$218,500	$76,451	$196,650	$56,139	90.0%	73.4%
C	$369,608	$254,838	$319,712	$180,160	86.5%	70.7%
D	$250,000	$91,289	$250,000	$68,153	100.0%	74.7%
E	$284,640	$172,157	$264,715	$153,891	93.0%	89.4%
F	$290,000	$140,768	$290,000	$83,838	100.0%	59.6%
Average	$260,236	$137,679	$244,957	$99,963	94.1%	72.6%

Damage avoided. The next table shows the actual damage suffered by each park and the damage which would have occurred had the parks been developed like the adjacent areas.

Had the entire 350.6 acres of City parks been developed, the estimated damage would have been between $18.2 million and $47.3 million, depending on the nature of the development, compared with the actual $7.4 million damage the parks suffered during Hurricane Floyd. Had half the park areas been left to convey flood water, the damage would have ranged from $9.1 million to almost $24 million.

Damage prevented by preserving open space			
Park	Actual Damage	Estimated Damage with Fringe Development	Damage Prevented vs. Fringe Development
Battle Park	$26,432	$728,000	$701,568
City Lake Park	5,500	2,700,000	2,694,500
Sunset Park	3,326,340	4,032,000	705,660
Total	$3,358,272	$7,460,000	$4,101,728

(This table was developed using damage of $52,000 per acre for Battle Park, $135,000 per acre for City Lake Park and $105,000 per acre for Sunset Park.)



Wilson

Wilson is a growing city in Nash County, in northeastern North Carolina (see map, page 3). There are no river gages on any of the streams which flooded Wilson during Hurricane Floyd. However, the City compiled peak stage data relative to the 100-year and 500-year flood elevations in the City's Flood Insurance Study. Flood elevations at the two locations discussed in this study are shown below:

Flood elevations at Wilson				
Stream	Location	100-year	Floyd	500-year
Toisnot Swamp	Toisnot Park	103	105.5	108
Hominy Swamp	Recreation Park	112	113	114

The parks. The City currently has credit for Activity 420 based on a default value for the impact adjustment ratio (rOS). For this credit it must only document that there are at least 5 acres of floodplain preserved as open space. The two parks used for this project are Toisnot and Recreation.

Park	Area (Acres)	Floodplain (Acres)	Fringe (Acres)
Toisnot Park	58.1	58.1	40.0
Recreation Park	21.1	21.1	10.5

These parks suffered no significant damage during Hurricane Floyd. Toisnot Park is primarily an open grassy area adjacent to a lake formed by Toisnot Reservoir Dam. About one third of the floodplain through the park is floodway.

A portion of the floodplain adjacent to the park is developed with residential buildings. Immediately adjacent to the park on the south side of Lawndale Drive are 21 similar residential duplexes valued at $70,000 to $100,000. Although there is a development of single family residences farther south. it is assumed that the park area would have been developed with duplexes like those on Lawndale had it not been preserved as open space.

Damage avoided. These 21 duplexes are on 5.5 acres at a density of roughly four units per acre. Using FEMA's Residential Substantial Damage Estimator (RSDE), the City estimated the average damage to these duplexes at $39,650 each. NFIP claims on 11 of these buildings that had insurance averaged $30,900. Using these two estimates gives an estimate of $118,000 to $151,000 damage per acre.

If the fringe of Toisnot Park had been developed in a similar manner, the additional damage would have been $4.7 million to $6 million. Since the flood elevation during Hurricane Floyd was about 2.5 feet higher than the BFE, such development would have suffered significant damage even if it had been built to the BFE.

Recreation Park is on Hominy Swamp north of U.S. Highway 264 (Raleigh Road). It is open space with some playground equipment. About half of the floodplain is floodway, and it is assumed that the floodway would not have been developed, although along other reaches of Hominy Swamp, 75% or more of the floodplain is developed, with a significant amount of development in the floodway.

On the east side of Canal Drive, eleven large homes were damaged by flooding from Hurricane Floyd. The estimated damage to eight of these houses was about $22,948 each according to the RSDE as estimated by the City. Based on that estimate, the total damage to the 11 houses was $252,428. These houses are located on approximately 11.9 acres, so the average damage per acre was about $21,000 per acre.

Damage prevented by maintaining parks as open space in Wilson			
Park	Actual Damage	Estimated Damage with Fringe Development	Damage Prevented vs. Fringe Development
Toisnot Park	$0	$5,400,000	$5,400,000
Recreation Park	0	222,000	222,000
Total	$0	$5,622,000	$5,622,000

(This table was developed using damage of $135,000 per acre for Toisnot Park and $21,000 per acre for Recreation Park.)
Had the 10.5 acres of flood fringe in Recreation Park been developed in a manner similar to that on the east side of Canal Road, the damage would have been about $222,000 more.

Conclusions

- The average damage prevented by preserving 86.4 acres as open space in three City parks in the flood fringe areas of the Tar River in Rocky Mount is estimated at about $4.1 million, or about $47,500 per acre.

- The above figure includes damage to several buildings in Sunset Park. Had those buildings not been there (they are being removed now), the damage prevented would have been about 50% greater, or about $70,000 per acre.

- In Wilson, the open space preserved in 50.5 acres in two City parks prevented an estimated $5.6 million in damage. This is an average savings of more than $111,000 per acre.

430 – Higher Regulatory Standards: Freeboard

In a floodplain management ordinance, a freeboard requirement means that new buildings will be protected to a level higher than the NFIP's base flood elevation (BFE). Freeboard is a term for an extra margin of protection. Ordinances or laws with a freeboard requirement add height above the base flood elevation to account for:

- future flood fringe development,
- uncertainties inherent with the flood insurance study methodologies,
- lack of data,
- waves or debris that accompany the base flood, and
- floods higher than the base flood.

These concerns have led most local governments in North Carolina to adopt elevation standards that exceed the minimum NFIP requirements. Sixty-nine percent of the local governments in North Carolina that participate in the NFIP require a freeboard elevation ranging from 0.5 feet to 5.7 feet above the base flood elevation. More than half of the participating communities, or 52%, have a freeboard of 2 feet or more.

Homes below the BFE can suffer significant damage

Activity Impact Measures. The benefits of freeboard can be measured by comparing the damage to buildings that have freeboard with the damage those buildings would have sustained if they were built to the BFE.

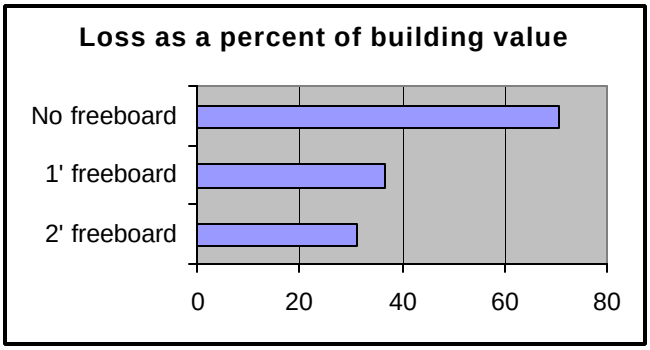
Wayne County and Goldsboro

Goldsboro is in Wayne County and the two government work together closely. Both require the lowest floor of residential structures, including manufactured housing units, to be elevated at least one foot above the base flood elevation.

During Floyd flooding, large portions of the County had flood levels in excess of the base flood elevations shown in the Flood Insurance Study. While the County's freeboard requirement did not save some of the structures from flood losses, the higher elevations did provide substantial flood loss reduction benefits.

Damage avoided. NFIP claims data for buildings in areas where flood elevations exceeded the base flood elevation were examined to determine the loss reduction value of freeboard. The results are displayed in the next table. Since flooding in these areas exceeded the base flood elevation, residential buildings built at the "zero" elevation had higher average loss than would be expected during the 100-year flood.

For this evaluation, because of the variation in building values, we use damage as a percentage of the value. According to these data, during Hurricane Floyd the average loss for structures with one foot of freeboard was $44,670 or 36.68% of the value of the building.



This was significantly lower than for those built at the base flood elevation (70.54%). The average loss for structures with two feet of freeboard was 31.21% of their buildings' value.

Floyd Claims by Freeboard for Elevated Structures

Freeboard	Number Structures	Total Value	Average Value	Building Loss	Contents Loss	Average Loss	Loss as a Percent of Average Value
Zero	8	$579,322	$72,415	$341,649	$67,026	$51,084	70.54%
1	13	1,583,095	121,777	494,178	86,526	44,670	36.68%
2+	9	892,637	99,182	266,708	11,924	30,959	31.21%
Total	30	$3,055,054	$101,835	$1,102,535	$165,476	$42,267	41.51%

Other higher regulatory standards. Recognizing the benefits of freeboard and of keeping structures out of the floodplain, in April 1998, Wayne County amended its subdivision ordinance by adding a provision that prohibits the establishment of any subdivision "on property entirely within the 100-year floodplain that requires the building of a new road."

Additionally, the amendment provides that subdivisions located "partially within the floodplain may be subdivided if each proposed lot contains an area outside the floodplain equal to the minimum lot size requirement, and any new road is built above the 100-year floodplain level."

Goldsboro is now considering similar changes to its regulations. The city council has scheduled a public hearing on ordinance amendments that would increase the freeboard requirement from one foot to two feet and prohibit the placement of manufactured housing units, including replacement units, in the floodway.

Goldsboro and Wayne County have manufactured home parks that were constructed in the floodway before their flood insurance studies were completed. Current policy allows replacement units if they are elevated and are no larger than the existing unit. The proposed regulatory changes are expected to reduce the potential for future flood losses.

Dare County

Although Hurricane Floyd's strength was greatly reduced by the time it reached Dare County, 254 flood insurance claims were paid to property owners in the County between September 16, 1999 and January 31, 2000. Of these claims, 51 were for elevated structures with lowest floor elevations at or above the base flood elevation, 55 were for non-elevated structures and most of the remaining claims were for pre-FIRM buildings where elevation data was not given and not used to rate the structure for insurance premium determinations.

While Dare County does not have a freeboard requirement, many property owners and builders construct their homes with the lowest floor above the base flood elevation. This practice resulted in lower flood insurance claims as a result of Floyd.

The 51 elevated structures with lowest floor elevations at or above the base flood elevation are non-basement buildings that meet the following construction criteria:

- The top of the elevated floor (all "A" zones) or the bottom of the lowest horizontal structural member of the lowest floor (all "V" zones) is above ground level.
- The building is adequately anchored.
- The means of elevation are pilings, columns (posts and piers), shear walls, fill (not in "V" zones), or solid foundation perimeter walls (not in "V" zones).

Damage avoided. As seen in the following table, elevated structures with freeboard have a lower average flood loss. Their flood loss as a percent of the structure's value is also lower. The data from Hurricane Floyd for these structures with one foot of freeboard had an average loss of $2,741 or 2.07% of the building's value.

For structures with two or more feet of freeboard the average loss was less than 1% of the building's value. According to the NFIP claims, buildings constructed to the base flood elevation suffered three times the damage, as a percentage of their replacement cost, than buildings elevated two or more feet above BFE.

Floyd Claims by Freeboard for Elevated Structures

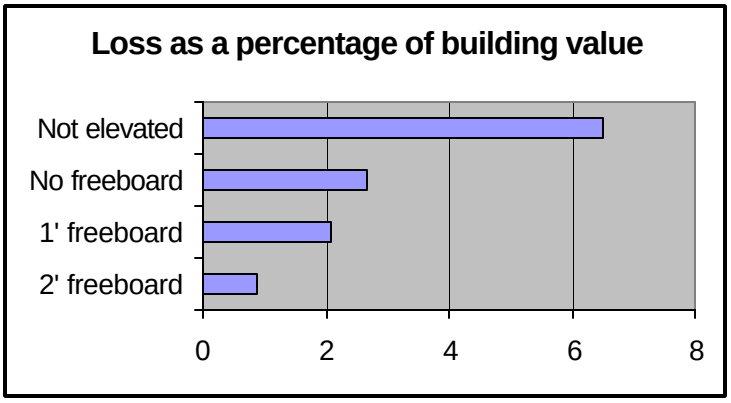
Freeboard	Number Structures	Average Value	Average Loss	Loss as a Percent of Structure's Value
Zero	13	$142,343	$3,803	2.67%
1	4	132,594	2,741	2.07%
2+	34	169,792	1,497	0.88%
Total	51	$159,878	$2,182	1.36%

The savings are even greater for elevated structures with freeboard than for non-elevated structures. The non-elevated structures in this category include those built on a slab, buildings with an attached garage at a lower elevation than the principal building area, and those with a crawlspace that is below grade on all four sides.

The non-elevated structures in the AE, A, X, and C Zones had an average loss of $6,343 or 6.51% of their average replacement cost (see table, below). According to the NFIP claims, non-elevated buildings in these zones suffered seven times the damage (as a percentage of their replacement cost) than those elevated two or more feet above BFE.

Floyd Claims by Flood Zone for Non-Elevated Structures				
Flood Zone	Number Structures	Average Value	Average Loss	Loss as a Percent of Structure's Value
AE, A3 – A6	39	$82,322	$6,127	7.44%
A	9	136,624	5,742	4.20%
X, C	7	131,459	8,316	6.33%
Total	55	$97,461	$6,343	6.51%

The difference is even greater when comparing losses for non-elevated buildings in the X and C Zones with losses for A Zone elevated buildings with their lowest floor two or more feet above BFE. The average loss for non-elevated buildings in the X and C Zones was $8,316 or 6.33% of their replacement cost.



Conclusions

- One of the best ways for reducing potential damages is to require new and substantially improved buildings in flood-prone areas to be elevated above the base flood elevation.

- Requiring one or two feet of additional protection above the base elevation, "freeboard" can provide up to twice the savings (as measured as a percentage of the building's value).

Elevated home in Dare County

430 – Higher Regulatory Standards: Coastal Regulations

Flood risks on North Carolina's barrier islands continue to change as they experience the normal process of coastal erosion. Areas that once provided protection from damage by coastal storms and hurricanes may lose their effectiveness as the beaches and dunes change their shape and size. As this happens buildings on the coast that are back from the shoreline will become more vulnerable, in part, because they tend not to be elevated and they are likely to have lower habitable areas or enclosures.

The NFIP regulations are designed to protect buildings from damage by floodwaters. They do not address loss of the supporting soil through erosion during a storm. Because this is a significant problem on the coast, the CRS provides credit for local regulations that prohibit new construction in an erosion-prone area.

Coastal erosion regulations. To receive CRS credit the regulations must, at a minimum, prohibit new construction within the area expected to erode over the next 30 years. In the 30 - 60-year erosion zone, the ordinance must prohibit new buildings larger than 5,000 square feet. Smaller buildings must be either prohibited or readily moveable.

In 1977 the North Carolina Coastal Resources Commission adopted coastal erosion hazard regulations and established statewide ocean-front setback standards. The setbacks are based on average annual long-term erosion rates, natural features at the site, and the type of development. At a minimum, all structures must be located behind the erosion setback line, the crest of the primary dune, or the landward toe of the frontal dune, whichever is the farthest landward.

North Carolina's setback standards were adopted in 1977

The erosion setback line extends landward from the first line of stable, natural vegetation to a distance equal to 30 times the average annual erosion rate at the site. In areas where erosion is less than two feet per year, there is a minimum setback required of 60 feet landward from the vegetation line.

Large-scale development, such as motels and condominiums, must meet an additional setback requirement. Any structure of more than four dwelling units or 5,000 square feet is to be set back from the first line of natural vegetation, a distance equal to 60 times the average erosion rate for the site. However, there is a "cap" on the length of the additional setback for large structures. If the large structure setback will be more than 105 feet longer than the 30-year setback, a distance of the 30-year setback plus 105 feet is used.

Activity Impact Measures. The benefit of coastal erosion setback regulations was measured by examining the cost of actual flood damage to residential structures caused by Hurricane Floyd. Flood losses were reviewed for residential structure setback zones 0-30 feet, 31-100 feet and more than 100 feet.

Data Collection. Hurricane Floyd came inland at Oak Island in Brunswick County as a category two hurricane with estimated maximum winds near 90 knots. The field survey team began by examining buildings along the oceanfront to identify those with similar structural characteristics. This assessment included information on the performance of the

- foundation system;
- building extensions, such as decks and porches;
- nonstructural building components such as below-building concrete slabs; and
- on-site building support utilities such as electrical, water and sewage services.

Field survey data were collected on 100 structures. The survey data were then merged with NFIP claims and policy data, along with setback observations taken from aerial photography. The initial field survey was limited to East Beach Drive between 16th and 58th Streets.

Buildings closest to the ocean had the most damage

A survey database was established and used to analyze the performance of the construction practices. These construction practices were cataloged based on:

- Presence or absence of enclosure
- Enclosure size
- Piling depth
- Piling depth in conjunction with the presence or absence of enclosure
- Piling depth in conjunction with the size of enclosures
- Piling depth in conjunction with the number of habitable stories
- Setback distances

After reviewing the available data matches for NFIP claims and setback distances, a decision was made to collect additional data. By broadening the study area and refining the search of the NFIP claims database, 174 claims were found, to which setback distances could be matched.

Collecting information on the distance of the structure from the first line of natural vegetation, the value of the property and the dollar value of flood damage from Hurricane Floyd for each structure were the next steps. This was used to establish average values and levels of damage within the study area for residential structures within the setback zones of 0 – 30 feet, 31 – 100 feet and more than 100 feet.

National Flood Insurance Program claims data for the period through January 31, 1999 were matched to the field data. The table below summarizes the flood losses for the 174 structures based on their position relative to the coastal setback reference feature shown on aerial photography taken May 9 through June 16, 1996. This photography was used to establish the relative position of structures to the first line of natural vegetation and the setback zones used to group structures for the analysis.

Floyd Claims by Setback Distance						
Setback Distance	Number Structures	Total Value	Average Value	Total Damage	Average Loss	Average Loss as a % of Structure's Value
0-30'	94	$11,686,527	$124,325	$3,226,803	$34,328	27.61%
31-100'	25	2,916,203	116,648	420,280	16,811	14.41%
100+'	55	6,153,879	111,889	501,197	9,113	8.14%
Total	174	$20,756,609	$119,291	$4,148,280	$23,841	19.99%

Damage avoided. Flood losses were highest in the area where structures were located directly on the open beach and in the 0 – 30 foot setback area. The average loss in these areas were twice as high as in the next landward zone, the 31 – 100 foot setback area and more than three times the loss experienced by structures 100 feet or more from the shore-line.

Conclusions

- Erosion protection regulations have a flood protection benefit. Coastal setback regulations can reduce flood insurance claims, disaster assistance payments and economic loss for the property owner.

- Using average losses as a percentage of building values shows that the farther back the building, the less the damage.

- Buildings that were more than 100 feet back had 1/3 the damage suffered by those buildings set back 30 feet.

430 – Higher Regulatory Standards: Enclosures

The conventional wisdom is that structures with enclosures below the base flood elevation will have higher flood losses than elevated structures with the lower area free from obstruction. While this is surely true, if one examines only the total loss data for structures, the aggregation of this data will present a different picture where other risk factors are more significant in determining the degree of loss.

Hurricane Floyd provides a good illustration. For example, if one looks at the total losses for structures with and without enclosures, the study data indicate that the average loss for structures with enclosures is $32,593 (see next table). The data suggest it is higher for structures without an enclosure, $37,866.

While a larger sample might show the reverse, the evaluation contract only provided for a survey of 100 buildings. Of those buildings surveyed, flood insurance claims data had only been reported on 43 of the structures by January 31, 2000. (This was the reporting date for the claims in the April 2000 report run for this project.)

Floyd Claims With and Without Enclosures (Oak Island)				
Enclosure	Number Structures	Average Value	Average Loss	Loss as a Percent of Structure's Value
Yes	26	$105,161	$32,593	30.99%
No	17	107,996	37,865	35.06%
Total	43	$106,282	$34,678	32.63%

Although the number of buildings with reported claims is low, there are enough claims to demonstrate how other factors influence the amount of loss that may be expected. To better illustrate the effects of enclosures on flood losses, the 26 claims for structures with enclosures were examined, with an emphasis on enclosure size and piling depth.

Enclosures under buildings on the coast were severely damaged

Enclosure size. As illustrated in the table on the next page, Oak Island flood losses were higher for buildings with larger enclosures. Buildings with larger enclosures (more than 300 ft^2) were more likely to be substantially damaged, experience structural failure to the foundation, and have significant damage to the upper habitable areas. It should be noted that the CRS credit for enclosure regulations differentiates between no enclosures and those less than 300 square feet.

The average flood loss and the loss as a percent of a building's value are greater for buildings with large enclosures than for buildings without enclosures and buildings with enclosures smaller than 300 ft^2. The average enclosure size for the nine buildings with enclosures larger than 300 ft^2 is 914 ft^2. In this set of buildings, the enclosure size and the flood loss as a percent of the building's value increased proportionally, both by 300%.

Floyd Claims by Enclosure Size				
Enclosure Size	Number Structures	Average Value	Average Loss	Loss as a Percent of Structure's Value
< 300 ft^2	17	$ 98,399	$16,891	17.17%
> 300 ft^2	9	117,935	62,254	52.79%
Total	26	$105,161	$32,594	30.99%

Enclosures and Piling Depth. In 1985, the North Carolina Building Code Council adopted new piling requirements that were effective January 1, 1986. These provisions require that vertical foundation members in erosion-prone areas be embedded 16 feet below existing grade or to –5 feet M.S.L., whichever is shallower. During Floyd the 1986 requirement was generally successful in protecting structures in areas of low ground elevation, where pilings had to be embedded to –5 feet M.S.L. This is significant because most of the buildings undermined by erosion in Oak Island were located in areas of low ground elevations.

Contractors generally started using square piles following the 1986 code changes that required deeper pilings and cross bracing. National Flood Insurance Program claims data were examined to see how enclosure sizes and piling depth affected flood losses.

Floyd NFIP Claims and Piling Depth				
Piling Code	Number Structures	Average Value	Average Loss	Loss as Percent of Structure's Value
Before 1986	9	$88,363	$25,219	28.54%
After 1986	25	100,833	19,991	19.83%
Total	34	$97,532	$21,374	21.92%

Although the data are for a small number of structures, they suggest the 1986 building code change that required deeper pilings helped reduce property losses. According to these data, during Hurricane Floyd the average loss for structures with deeper pilings was $19,991 or 20% of the building's value, as compared to losses of 28.5% of the building's value for shallower pilings.

Damage avoided. The importance of piling depth is emphasized when one looks at the combination of shallow pilings and the presence of an enclosure. Buildings with enclosures and those without enclosures both have higher losses if they also have shallow pilings (see next table).

Floyd Claims by Piling Depth and Enclosure					
Piling Code	Enclosure	Number Structures	Average Value	Average Loss	Loss as a Percent of Structure's Value
Before 1986	Yes	5	$91,972	$27,512	29.91%
	No	4	83,853	22,352	26.66%
After 1986	Yes	18	100,932	19,780	19.60%
	No	7	100,581	20,535	20.42%
Total		34	$97,532	$21,375	21.92%

According to the data collected, the average flood loss from buildings with enclosures and shallow pilings (29.91%) was higher than for buildings with enclosures but with pilings that met the deeper penetration requirements of the 1986 code (19.6%).

The average flood loss for buildings with no enclosure and shallow pilings (26.66%) was higher than for buildings with no enclosure but with deeper pilings (20.42%). Likewise, the average flood loss for buildings with shallow pilings and enclosures (29.91%) was higher than for buildings with shallow pilings and no enclosure (26.66%).

While the depth of the pilings and the presence or absence of an enclosure can have a significant impact on the value of the flood loss, the size of the enclosure is also an important factor when considering how large the loss might be for a particular building.

Floyd Claims by Piling Depth and Enclosure Size					
Piling Code	Enclosure Size	Number Structures	Average Value	Average Loss	Loss as a Percent of Structure's Value
Before 1986	< 300 ft^2	4	$92,759	$23,741	25.59%
	> 300 ft^2	1	88,825	42,598	47.96%
After 1986	< 300 ft^2	13	100,134	14,784	14.76%
	> 300 ft^2	5	103,004	32,769	31.81%
Total		23	$98,984	$21,461	21.68%

According to these data, the average flood loss from buildings with large enclosures and shallow pilings (47.96%) was higher than buildings with small enclosures and shallow pilings (25.59%). Buildings with large enclosures and deep pilings (31.81%) experienced an average flood loss higher than buildings with small enclosures but with deep pilings (14.76%).

Oceanfront homes with enclosures and shallow pilings had the highest flood losses

Conclusions

- While it first appears that buildings with enclosures suffered less flood losses than those without enclosures, other factors (piling depth and date of construction) are the more important determinants of damage.

- Both piling depth and enclosure size can significantly affect the value of the flood loss for structures along the shoreline.

- Due to the limited number of structures studied and the limited flood insurance claims data included in the January 31, 2000 claims report file, the relative importance of these two factors cannot be established by this evaluation.

- As barrier islands erode and the V Zone moves inland, the problem with piling foundations installed to older standards and buildings with enclosures will increasingly contribute to disaster losses. CRS credit is provided to encourage communities to require site-specific foundation construction standards. Foundation Protection (FDN) credit is not available in coastal high hazard areas because the minimum NFIP regulations require engineered foundations in V Zones. Consideration should be given to crediting retrofit programs that address inadequate piling foundations.

500 Series – Flood Damage Reduction

Background

This CRS series credits activities that directly reduce flood losses. Two activities were selected for evaluation, 520 (Acquisition and Relocation) and 530 (Retrofitting). It was expected that North Carolina communities would have many examples to look at because FEMA funded many acquisition and retrofitting projects in 1998 following Hurricane Fran. However, the project team discovered that many of those projects had not been completed before Hurricane Floyd.

520 – Acquisition and Relocation

The surest way to protect a building from flood damage is to remove it from the floodplain. The most common method of doing this is for a government agency to acquire the property and demolish the building or move it to high ground. A less frequently used approach is for the owner to relocate it to high ground, either on the same lot or on a different one.

CRS Activity 520 (Acquisition and Relocation) credits either approach as long as an insurable building is removed from the path of flooding and the community can document that the property will stay vacant.

Activity impact measures. The impact of this activity can be measured by looking at what type of damage buildings would have received from Hurricane Floyd if they had not been removed from the floodplain. If adequate records on the buildings are available, avoided damage can be estimated based on the actual depth of flooding. If the building type and elevation are not known, the damage to similarly situated nearby buildings can be calculated and extrapolated.

The utility of this approach rests on having an adequate number of "typical" situations. If, for example, a community acquired and demolished a factory or historical structure, it would be difficult to extrapolate the conclusion to other communities. Such situations are not transferable.

Wayne County

The setting. The principal sources of flooding in Wayne County are the Neuse and Little Rivers. Flooding results primarily from tropical storms and large weather fronts. Recently the county experienced flooding during Hurricanes Bertha, Fran and Floyd, and Tropical Storm Josephine.

In some areas the floodplain is very wide. The Neuse River floodplain at Goldsboro is about 3 miles wide and there is significant development in the floodplain. The Little River floodplain is about 1.5 miles wide, but developed with a lower density. In both areas, many homes have been flooded on more than one occasion.

Acquisition project. After Hurricane Fran, Wayne County applied for a FEMA Hazard Mitigation Grant Program (HMGP) grant to purchase floodprone residences in five unincorporated "pocket neighborhoods" along the Neuse River. All of these areas had been subject to repetitive flooding.

The project includes 37 single family residences and two mobile home parks with 69 mobile homes. Upon closing, all improvements are to be demolished. The land is to be cleared and converted back to its natural state. A deed restriction will be placed on the property to ensure the land will be held as open space in perpetuity.

Manufactured homes in this park were purchased and families relocated to areas outside the flood hazard area

Only 23 properties had been acquired and cleared before Hurricane Floyd struck in September 1999.

During Floyd flooding, large portions of the County had flood levels in excess of the base flood elevations shown in the Flood Insurance Study. This experience and that of other flood events prompted several property owners to volunteer for the new Post-Floyd buyout program. The county has made application for HMGP funds to purchase 193 additional homes.

Following Hurricane Fran, several pre-FIRM homes were elevated because the flooding substantially damaged them. Unfortunately, some of these were flooded again in Floyd because the flood level exceeded the base flood elevation. This experience shows one advantage of acquisition over retrofitting and the need for freeboard when retrofitting.

State analysis. A benefit-cost analysis was performed by the State for the proposed HMGP Project using the *Riverine Flood Benefit-Cost Module* produced by FEMA. The results of the study are summarized in the table on the next page.

To reduce time and effort in preparing the analysis, the State grouped structures that shared similar characteristics of building type, square footage and quality of construction. Additionally, based on the assumption that flood damage and associated costs are related to the depth of flooding within the structure, the properties were sorted into groups using the difference between the finished floor elevation and the base flood elevation at the 100-year level.

Using this analysis, the state concluded that the project offered a flood loss reduction benefit of over $1,470,000. Since the project will remain as open space, no future flood loss is expected at these sites. Thus, no future flood damage was calculated to offset the expected benefit.

Wayne County Acquisition and Relocation Project					
Structure Identification	Replacement Value	Lowest Floor Below BFE	Project Benefits	Flood Damage After Acquisition	
				Depth	Damage
A	$79,280	-1	$26,486	0	0
B	63,820	-1	26,486	0	0
C	78,933	-1	26,486	0	0
D	53,053	-2	46,535	0	0
E	77,264	-2	46,535	0	0
F	54,548	-2	46,535	0	0
G	47,458	-2	46,535	0	0
H	62,120	-2	46,535	0	0
I	56,284	-2	46,535	0	0
J	74,310	-3	90,459	0	0
K	47,541	-3	90,459	0	0
L	51,929	-3	90,459	0	0
M	61,876	-3	90,459	0	0
N	89,504	-4	173,771	0	0
O	58,298	-4	173,771	0	0
P	12,949	-1	38,659	0	0
Q	31,431	-1	51,912	0	0
R	21,081	-1	39,788	0	0
S	29,440	-1	39,788	0	0
T	21,231	-1	39,788	0	0
U	23,118	-1	39,788	0	0
V	13,864	-1	81,142	0	0
W	16,175	-2	72,390	0	0
TOTAL	$1,125,507		$1,471,301		0

Conclusions

- Acquisition and relocation of floodprone buildings is more effective at reducing flood losses than any other approach.

- Unfortunately the grant funding and acquisition process is very slow. Three years after Hurricane Fran substantially damaged them, many properties had still not been cleared.

- For those that were, the benefits were great. Using the replacement cost of the flooded buildings, the theoretical benefit/cost ratio was 1,471/1,125 or 1.3:1. In the real world, FEMA and the community had a payback in three years.

530 - Retrofitting

CRS credit is provided for buildings that have been modified to protect them from flood damage. Five retrofitting techniques are recognized:

- Elevating a building above flood level.
- Protecting the building with a barrier, such as a levee, floodwall, or berm.
- Dry floodproofing (sealing a building to prevent floodwaters from entering).
- Wet floodproofing (letting water in, but removing contents and modifying the structure so there is little or no damage).
- Protecting a basement from sewer or sump backup.

Activity impact measures. The impact of retrofitting can be measured by comparing the damage to retrofitted buildings with the damage to similar neighboring buildings that had not been retrofitted. Percent damage is used rather than dollar damage because of differing property values (some retrofitted buildings were remodeled and worth more than their non-retrofitted neighbors).

The depth/damage results were compared with damage data collected from NFIP claims. State and FEMA disaster assistance costs were not available for the evaluation.

Severn

Severn is discussed at the beginning of the section on the 400-series. It has few buildings in the floodplain, but one critical facility is there. After the July 1995 flood, the Town's sewage lift station was rebuilt at a cost of $89,000.

As part of the reconstruction, a four-foot concrete floodwall was built around the lift station at an elevation of about 59′ M.S.L. During Hurricanes Fran and Floyd, floodwaters rose to a foot from the top of the wall.

This wall, built largely with Community Development Block Grant funds for about $6,000 has prevented flooding of the lift station twice since 1996. This comes out to a savings of $72,000 or $43,000 per year. This is a 2,900% return on the investment.

Severn's lift station: 1995

Severn's lift station: 2000

Belhaven

The Town of Belhaven (population 2,244) was settled in the late eighteenth century in the floodplain at the confluence of Pantego Creek and the Pungo River. The topography in the area is generally flat, with the highest elevation in the area less than 10 feet above the National Geodetic Vertical Datum. According to the Flood Insurance Rate Map, all of Belhaven and its extraterritorial jurisdiction area are located in the Special Flood Hazard Area.

The main sources of flooding are the Atlantic Ocean, Pamlico Sound, Pantego Creek and the Pungo River. Belhaven's dominant source of flooding is storm surge generated in the Atlantic Ocean by tropical storms and hurricanes.

During the past 70 years, moderate to severe floods have occurred in Belhaven on 12 occasions. From 1996 to 1999, Belhaven was flooded on six occasions by hurricanes and tropical storms.

- July 1996 – Hurricane Bertha brought 5.4-feet water through Belhaven.
- September 1996 – Hurricane Fran brought 6.8 feet of water and damaged 735 of Belhaven's 980 homes (average damage of $10,000 per home)
- October 1996 – Tropical Storm Josephine
- August, 1998 – Hurricane Bonnie
- September 1999 – Hurricane Dennis
- September 1999 – Hurricane Floyd

Since 1996, the National Flood Insurance Program has paid approximately $4.9 million to 143 property owners with repetitive flood losses (355 claims). These claims had an average payment of $13,782. Thirty of the properties had five or more claims during this period.

The projects. Following Hurricane Fran, Belhaven initiated a multi-year program to elevate 379 houses using FEMA's Hazard Mitigation Grant Program. Thirty-two homes in Belhaven had been elevated by the time Hurricane Floyd struck.

The data. Records from 27 of these properties were available for review during the survey. Damage estimates were not included in the files; however, engineering inspection reports were available. These reports were used to develop damage estimates using FEMA's *Coastal Flood Benefit-Cost Module.* For these structures the Team also had available cost data from the close-out report or contractor bid documents. Thus, project cost for the *Coastal Benefit-Cost Module* could be based on more accurate data and not preliminary damage/cost estimates taken immediately after the storm.

Using this data, the benefit-cost module was run for each elevated structure. The first "flood depth" column in the table on the next page shows the depth of water above the first floor that would have occurred during Hurricane Floyd without the elevation project. These flood depths range from 1.8 to 4 feet.

Belhaven Elevation Retrofit Project – Expected Damage From Floyd				
Structure Identification	Before Mitigation		After Mitigation	
	Flood Depth	Damage	Flood Depth	Damage
A	3.7	$18,144	-1.0	$6,139
B	3.0	18,771	-1.0	3,996
C	2.8	13,541	-1.0	2,883
D	2.8	19,443	-2.0	2,240
E	2.9	16,752	-1.0	3,567
F	2.1	14,994	-1.0	3,299
G	3.1	18,119	-1.5	2,088
H	1.9	33,915	-4.8	0
I	3.6	36,144	-1.0	5,218
J	2.8	15,147	-1.0	3,225
K	2.6	20,528	-2.0	2,365
L	4.0	16,776	0.0	4,694
M	2.9	18,988	-1.0	4,043
N	2.5	52,319	-1.0	5,569
O	3.9	15,611	-1.0	3,095
P	4.0	17,136	0.0	5,829
Q	2.0	16,547	-2.0	3,978
R	1.8	11,264	-2.0	2,708
S	4.0	15,781	-2.0	1,683
T	2.6	21,326	-2.0	1,851
U	3.2	19,901	-1.0	1,728
V	2.9	25,021	-1.0	5,327
W	2.8	26,300	-1.0	5,599
X	3.2	26,366	-1.0	5,613
Y	3.2	15,147	-1.0	3,225
Z	2.8	48,521	-1.0	10,330
AA	3.4	24,174	-1.0	5,147
Total		$596,576		$105,439

The third column shows a summary of the expected Floyd losses for each building if it had not been elevated. The expected losses for these 27 buildings totaled $596,576. This included $371,609 for building damage and $224,967 for contents damage. Detailed tables of the expected damage using the benefit-cost module are available, but not included in this report.

The second "flood depth" column shows the depth of flooding at each building during Floyd. All of these flood depths are at or below the first floor and have values from –4.8 to 0 feet

Crawlspace damage. Local building officials verified that floodwater from Hurricane Floyd did not enter the habitable areas of any of the homes that had been elevated. However, that doesn't mean they didn't have flood losses.

These homes were elevated on a perimeter foundation that consists of a continuous wall and footing with interior floor supports. The crawlspace area is sometimes used for storage, duct work for heating and air conditioning and insulation for the floor.

This Belhaven home was elevated after Hurricane Fran and was above Floyd's floodwaters.

Additionally, typical exterior improvements can add to the value of the flood loss. Following Hurricane Fran, a team of engineers from the State of North Carolina developed estimates on the effects of –2, -1, and 0 water levels on typical structures elevated on a crawlspace.

These estimates were used as "User-Entered Depth-Damage Function" for flood depths –2, -1, and 0. Without this addition, the Default Depth-Damage Function percentage would have been zero.

The last column shows a summary of the expected Floyd losses for each elevated building. The expected losses for these 27 elevated buildings totaled $105,439. This included $42,716 for building damage and $62,723 for contents damage.

A comparison of these estimates indicates that flood losses from Hurricane Floyd were reduced by more than $490,000 due to the elevation of these structures. This represents an average saving of $18,190 for each structure.

Pairing with non-retrofitted buildings. To see how these depth-damage values performed in estimating losses at these depths during Floyd, 27 additional buildings were added to the analysis. These structures were not elevated before Hurricane Floyd. These buildings were paired with the elevated buildings in the preceding table according to the ID in the first column. The paired buildings are located near each other and are of similar construction.

The next table, "Expected Damage to Non-Elevated Buildings in Belhaven" shows the estimated percent damage to each building based on the depth/damage curves and replacement cost.

The first "flood depth" column in the next table shows the depth of water above the first floor during Hurricane Floyd. These flood depths range from 1.4 to 3.5 feet. The third column shows a summary of the expected Floyd losses for each non-elevated building .

Based on the depth/damage curves, the expected losses for these 27 buildings totaled $600,591. This included $375,371 for building damage and $225,220 for contents damage.

The second "flood depth" column shows the depth of flooding at each building that would be expected during Floyd based on the proposed lowest floor elevations in the mitigation project description. All of these flood depths are at or below the first floor and have values from –1 to –2 feet.

The last column shows a summary of the expected Floyd losses for each building when it is elevated. Once elevated, the flood losses for these 27 buildings in a storm like Floyd are expected to be approximately $147,442. This includes $58,976 for building damage and $88,465 for contents damage.

Expected Damage to Non-Elevated Buildings in Belhaven				
Structure	Without Elevation		With Elevation	
Identification	Flood Depth	Damage	Flood Depth	Damage
A	2.2	$16,526	-1	$7,341
B	3.0	17,856	-1	5,729
C	4.0	15,488	-1	4,472
D	1.6	13,448	-2	3,233
E	2.2	29,990	-1	7,872
F	2.7	29,744	-1	6,362
G	2.5	25,013	-1	5,350
H	2.7	35,078	-1	7,503
I	2.3	18,470	-1	8,205
J	3.5	36,960	-1	10,672
K	1.4	13,440	-2	3,000
L	2.5	19,685	-1	6,316
M	2.6	19,771	-1	6,343
N	2.6	34,387	-1	7,355
O	2.2	23,355	-2	3,318
P	1.6	18,973	-2	2,695
Q	2.1	13,489	-2	3,243
R	1.5	14,080	-2	2,000
S	1.4	10,339	-2	3,590
T	1.5	12,043	-2	2,895
U	3.0	18,014	-1	3,853
V	3.1	21,298	-1	4,555
W	2.7	37,714	-1	8,067
X	2.6	44,734	-1	9,568
Y	2.6	13,694	-1	2,929
Z	3.0	27,994	-1	5,988
AA	2.3	19,008	-1	4,990
	Total:	$600,591		$147,442

A comparison of these estimates indicates that flood losses from Hurricane Floyd would have been reduced by more than $450,000 if the buildings had been elevated before the storm. This represents an average saving of $16,783 for each structure.

A look at the details (table not included with this report) found that damage to the non-elevated buildings ranges from 9% (of the building's value) in a two story building where the flood was two feet over the first floor to 27% where it was three feet deep in a one story building. Contents damage was a higher percentage of the building's value because contents are more susceptible to damage from shallow water. It ranged from 19.5% to 40.5%. Total damage to the buildings ranged from 10% to 31% of the value of the buildings and their contents.

The project team looked at the anticipated effect of elevating these structures above the base flood elevation. It was found that damage to the buildings (once elevated) ranges from 2% for a two-story building where the flood was two feet below the first floor to 3.7% where the flood depth is one foot below the lowest floor in a one-story building.

As with the non-elevated buildings, contents damage is a higher percentage because contents are more susceptible to damage from shallow water. It ranged from 7% to 14%. As indicated earlier, contents damage was included because of the practice of using the crawlspace for storage. Total damage to the buildings is expected to range from 3% to 7%.

Calibration with NFIP claims. The Team's next step was to compare the depth/damage results with damage data collected from Hurricane Floyd NFIP claims. Not surprisingly, only one NFIP policy or claim could be matched with a retrofitted property. Due to the limited data, a comparison of the results of the *Coastal Benefit-Cost Module* with the NFIP claims data was not undertaken.

On the other, hand, matches were made with 11 of the non-retrofitted buildings. This allowed a comparison of the damage estimates with the NFIP claims. A significant difference was found and is shown in the next table.

B/C Model and NFIP Claims Compared

Structure Identification	Flood Depth	B/C Model Expected Damage	NFIP Claims
C	4.0	$15,488	$5,231
G	2.5	25,013	7,309
I	2.3	18,470	31,000
J	3.5	36,960	12,040
M	2.6	19,771	3,259
N	2.6	34,387	8,660
P	1.6	18,973	5,027
V	3.1	21,298	5,996
X	2.6	44,734	9,273
Z	3.0	27,994	12,418
AA	2.3	19,008	3,126
Total		$282,096	$103,339

Two factors explain the primary reasons for these difference. The building and contents values used in the benefit-cost analysis are 39% higher than those reported in the NFIP claims and policy files. The values used in the B/C module were obtained from the mitigation files. These values were based on house measurements and replacement cost values developed jointly by the local government and the state.

The second major factor contributing to the difference was the use of different flood depths. The mitigation files generally reported higher flood depths within the structures. A review of the claims and mitigation files showed they reported the same flood depth for two properties. The mitigation program used higher flood depths for seven properties and the insurance file had higher flood depths for two properties.

Other differences such as no contents coverage contributed to part of the difference, but were not as significant as the difference in property value and depth of flooding.

Dare County, Village of Avon

Avon's flooding situation and the program that promoted retrofitting in the village is explained in the section on public information, page 15.

The data. Records from 11 of the 40 retrofitted properties were reviewed during this project. Damage estimates were not included in the available files. However, records from the building and tax departments, and interviews with the property owners provided enough information to estimate project costs and benefits. This information was used to develop damage estimates using FEMA's *Coastal Flood Benefit-Cost Module.*

Retrofitted home in Avon

Local officials and residents reported that Hurricane Emily (August, 1993) produced higher water elevations than Hurricane Floyd had. This was verified by a review of the NFIP claims files for 140 buildings in the study area. This review found the 42 claims following Hurricane Emily for an average flood loss of $22,996.

Following Floyd only 3 claims were reported in the file through January 31, 2000 and these had an average loss of $1,857. Since Emily was the larger storm with flood elevations near the 100-year frequency reported in the Flood Insurance Study, it was decided to use data from Hurricane Emily in the analysis.

The results from the benefit-cost module are summarized in the table below. The first "flood depth" column shows the depth of water above the first floor that would have occurred during Hurricane Emily without the elevation project. These flood depths range from 2 to 4 feet.

Avon Damage Estimates Before and After Elevation				
Structure Identification	Before Elevation		After Elevation	
	Flood Depth	Damage	Flood Depth	Damage
A	3	$17,571	-1	$2,412
B	2	16,374	-1	3,677
C	3	23,926	-1	4,361
D	2	13,162	-1	2,481
E	3	12,522	-1	1,719
F	3	27,770	-1	3,812
G	3	34,216	-5	0
H	4	19,635	-5	0
I	3	24,078	0	6,194
J	4	21,505	-5	0
K	2	9,191	-4	0
Total		$219,950		$24,656

The third column shows a summary of the expected Emily losses for each building if it had not been elevated. The expected losses for these 11 buildings totaled $219,950. This included $149,417 for building damage and $70,917 for contents damage.

The second "flood depth" column shows the depth of flooding for each building during Emily. All of these flood depths are at or below the first floor and have values from –5 to 0 feet.

Local building officials verified that floodwater did not enter the habitable areas of any of the homes that had been elevated. However, that doesn't mean they would not have flood losses even though elevated on pilings. Areas beneath the house are generally open but exposed ductwork for heating and air conditioning and insulation for the floor may become damaged. Accordingly, changes to the benefit-cost module were made using the "User-Entered Depth-Damage Function."

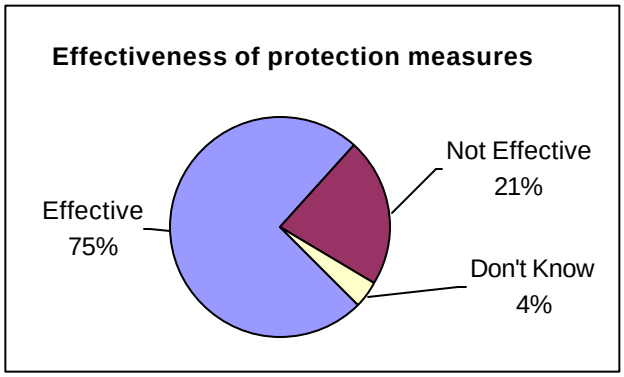
The last column shows a summary of the expected Emily losses for each elevated building. The expected losses for these 11 elevated buildings totaled $24,656. This included $9,861 for building damage and $14,795 for contents damage.

A comparison of these estimates indicates that flood losses from Hurricane Emily would have been reduced by more than $195,000 if the elevation of these structures had taken place before the storm. This represents an average saving of $17,754 for each structure.

Residents Survey

The telephone survey of 206 floodplain n residents is discussed at the beginning of the section on the 300 Series of public information activities. On pages 13 – 14, it is noted that 75 respondents had installed a property protection measure, such as elevating all or parts of their buildings above the flood level.

Effectiveness of retrofitting. These respondents were then asked "Did your protection measure(s) prevent or reduce your flood damage?" In both sets of communities, the flood protection measures had approximately a 75% success rate in preventing or reducing flood damage. This is encouraging.



There is no significant difference between the CRS and non-CRS communities. Because the number of respondents is relatively small and because when evaluating the benefits of retrofitting, it does not matter whether it was credited by the CRS, the rest of this section does not differentiate between the types of communities.

Causes of failures. Those whose measures were not effective were asked why their measures failed. The responses for both the CRS and non-CRS communities were:

Why measure did not protect from Floyd flooding	No. Respondents
Measure not actually installed, waiting for funding	6
Measure not high enough or not strong enough	2
Measure not appropriate for type of flooding that occurred	3
Measure actually did protect to some degree	2
Other	2
Total responses	16

Given the first reason (the measure was not installed), the responses to the previous questions on whether the house was retrofitted before Floyd are suspect. It is concluded that the actual pre-Floyd retrofitting rate is probably smaller than shown, but the success rate of the measures (in preventing or reducing some of the damage) is probably higher than 75%.

Damage prevented. A following question posed to the 56 respondents who reported that their property protection measure was effective. "Approximately how much damage was prevented or money saved because you took this action?"

How much was saved	Avg. savings	No. Respondents	Total savings
Less than $5,000	$2,500	22	$55,000
$5,000 to less than $10,000	$7,500	15	$112,500
$10,000 to less than $20,000	$15,000	4	$60,000
$20,000 to less than $30,000	$25,000	5	$125,000
$30,000 to less than $40,000	$35,000	2	$70,000
$40,000 or more	$40,000	8	$320,000
Total		56	$742,500
Total average savings			$13,259

Except for the respondents who reported saving over $40,000, the results fall in a pattern – most people saved a little. There was no relation between the type of measure used and the amount of funds saved, although this is a difficult question. Not everyone can tell the value of what did not happen.

However, given the values above, it can be said that of the 56 people who reported having successfully retrofitted their homes, their average savings was $13,259. Of the 75 people who reported doing something (both effective and not effective), the average savings was $9,900. From a community perspective, promoting retrofitting saved almost $10,000 per property, even if as many as 25% of the measures are not successful during a very large flood.

Conclusions

- Elevated buildings suffered little or no damage. In Belhaven, the non-retrofitted buildings suffered damage to their structures and contents up to 27% and 40% respectively.

- The practice of elevating above the base flood elevation paid off: the higher the building, the less the damage.

- In Avon, elevating the 11 buildings that were studied would save $24,000 per building if Hurricane Emily came again. Even more was saved during the lower flooding caused by Hurricane Floyd.

- Based on the residents' survey results:

  - Where people had installed flood protection measures, they proved effective against Hurricane Floyd's flooding in 75% of the cases.

  - Among the most common measures installed were the less expensive ones of moving a furnace or water heater above flood levels, moving contents out of harm's way, and securing loose objects in the yard.

  - 60% of those who had successful retrofitting projects saved over $5,000 in flood damage prevented. The average savings for all retrofitters was $9,900.

Overall Impact of the CRS

Background

Over the years, local officials have reported that the Community Rating System has had an impact on the way they do business that is not reflected in the credited activities. For example, many have organized and coordinated their flood protection programs for the first time. This evaluation effort included a review and analysis of these spin-off benefits.

The nine CRS Coordinators' interviews included eight questions on the overall impact of the CRS. The questions and their responses are summarized on the next page.

Findings

Initiation of new activities. The first few questions strove to determine if the CRS was the catalyst or reason for the communities starting new floodplain management activities. All nine communities reported starting new activities and some of them were done solely for CRS credit.

Most of these were 300-series public information activities. This is not surprising since 310 (Elevation Certificates) is mandatory to participate in the program. The others are relatively inexpensive to undertake (usually only requiring some staff time) and have previously been reported as the most common new projects for CRS credit.

There is one interesting exception to this usual finding. Belhaven reported starting a flood warning and response program (Activity 610) because of the CRS, although it noted that recent flooding contributed to its interest in the topic. Again, this is an activity that requires staff time, not necessarily a major expenditure of funds.

The CRS Coordinators were also asked "Has the CRS gotten your community to do things it would not have done otherwise?" Four of the nine communities said "yes." Belhaven noted the new flood warning program, better planning and coordination, and a more effective public information program. The other three mention initiating or changing their public information activities.

Several times throughout the interviews, the local officials noted that recent flooding and post-disaster mitigation funding were often greater instigators of change than the CRS. This was especially true of the high price activities, 520 (Acquisition and Relocation) and 530 (Retrofitting).

CRS Coordinators' Interviews	Belhaven	Goldsboro	Havelock	Oak Island	Whiteville	Wilson	Dare County	Lenoir County	Wayne County
Approximate number of buildings in SFHA	All	400	28	210	100	400	850	700	700
CRS Class	8	9	8	9	9	9	8	9	9
Population (in thousands) (1)	2	41	20	6	5	39	28	60	112
Which of your CRS activities were started or modified during or after the CRS application?	330 510 530 610	310	320 330	350 330	330	330 420 520 (3)	330	310 320 540	430 520
Which activities were implemented solely for CRS credit?	610	310	All	All	330	(2)	330	310 320	(4)
Did the new activities have an impact on damage from Hurricane Floyd flooding?	330	No	No	No	Not sure	No	Not sure	No	520
Have the activities affected other losses from local storms or other flooding?	No	No	No	No	N/A	No	Not sure	No	Not sure
For those items that were successful, to what do you ascribe their success?	(5)	N/A	N/A	N/A	(5)	(5)	(5)	N/A	(3)
Has your community changed the way it is organized for flooding or revised its overall approach to dealing with flood problems since it began in the CRS?	Yes	No	Yes	No	Yes (2)	Yes (2)	Yes	No	Yes
Has the CRS gotten your community to do things it would not have done otherwise?	Yes	No	Yes	Not sure	(2)		Yes	Yes	
What is your subjective opinion of the CRS? (Codes: + - positive, N – neutral $ - like the insurance savings)	+	N (2) (3)	+ $	N	+ $	+ $		+	+ $

Notes:

1. County populations include incorporated areas
2. Recent flooding was more important than the CRS
3. Mitigation funding was more important than the CRS
4. Flood loss reduction benefit was more important than the CRS
5. People are more interested because of recent flooding

Impact of the new activities. Several questions focused on whether the new activities were helpful during Hurricane Floyd or other storms or floods. The responses were mostly "no" or "not sure." Belhaven noted that people were more knowledgeable about what to do and Wayne County counted 32 homes that had been removed from the flood-plain before Floyd.

Wilson said that the new activities "probably" did not have an impact on Hurricane Floyd flooding, but then noted that after Floyd, attitudes changed from skepticism to more support of floodplain management. As with several other communities, it was difficult for the respondents to separate the impact of CRS from that of flooding and funding.

Overall impact. Six of the nine communities reported that they had changed the way they approach dealing with flooding since they joined the CRS. However, in several cases, flooding and funding were more important motivators.

Six of the nine also had positive responses to the question "What is your subjective opinion of the CRS?" The other three were either neutral or did not respond. While there were no negative responses, there was only one strongly positive one – Belhaven.

Conclusions

Data problems

- The number of CRS Coordinators interviewed was small and they were from different types of communities (large and small, inland and coastal). It is hard to draw solid conclusions from such a small and varied sample.

- The impact of the recent flood and the subsequent mitigation efforts likely made it difficult for them to separate pre-Floyd CRS activities from post-Floyd work.

- While the CRS may not have been the instigator for a new activity, it may have been the source of information on how to implement it. This was a question that was not asked.

- While objective measurements can be made of activities like acquisition and relocation after a flood, the project team is not sure that that is the best time to pursue subjective inquiries, such as the overall impact of the CRS.

CRS as a change agent

- The CRS was the cause for starting or modifying some local activities.

- However, in many cases it was not the only cause and it was overshadowed by recent flooding (including those before Floyd) and disaster assistance funds. Further, the project team interviewers reported that communities were generally already doing good things before they joined the CRS.

- The CRS had a greater impact on activities that are inexpensive or can be implemented with current staff resources (e.g., public information and flood warning).

- The impact of the CRS goes beyond the impact of the individual credited activities. Communities reported that some programs were better coordinated.

Overall impact

- The nine communities' CRS Coordinators were generally positive about the CRS.

- Generally, the Class 8 communities were more positive than the Class 9 communities. Those that fared best may well like the program more. Belhaven, a small town (Class 8) that is completely floodprone, reported getting the most from its CRS participation.

Conclusions

300 Series – Public Information Activities: Residents of CRS communities: had a higher level of awareness that they were exposed to a flood hazard, had a higher level of flood insurance coverage, and had implemented more flood protection measures. However, when asked where they got the information for these things, we found no significant impact due to community-run public information programs.

400 Series – Mapping and Regulations:

- The combination of having base flood elevations and requiring new construction to be built to a freeboard of two feet above the BFE saved nearly $100,000 in the small community of Severn.

- The average savings from preserving floodprone areas as open space ranged from $47,500 to $111,000 per acre.

- Requiring a freeboard of one or two feet of additional protection above the base elevation can provide up to twice the savings that result from meeting the minimum NFIP requirement (as measured as a percentage of the building's value).

- Erosion protection regulations that require buildings to be set more than 100 feet back resulted in 1/3 the damage suffered when compared to buildings that are set back only 30 feet.

- Both piling depth and enclosure size can significantly affect the value of the flood loss for structures along the shoreline.

500 Series – Flood Damage Reduction:

- Acquisition and relocation of floodprone buildings is more effective at reducing flood losses than any other approach. Using the replacement cost of the flooded buildings, the theoretical benefit/cost ratio was 1.3:1. Using actual experience, 1996 – 1999, FEMA and the community had a payback in three years.

- The practice of elevating above the base flood elevation paid off: the higher the building, the less the damage.

- Where people had installed flood protection measures, they proved effective against Hurricane Floyd's flooding in 75% of the cases. 60% of those who had successful retrofitting projects saved over $5,000 in flood damage prevented. The average savings for all retrofitters was $9,900.

Overall Impact of the CRS

- The CRS was the cause for starting or modifying some local activities. However, in many cases it was not the only cause and it was overshadowed by recent flooding and disaster assistance funds.
- The CRS had a greater impact on activities that are inexpensive or can be implemented with current staff resources (e.g., public information and flood warning).

Appendix A. Telephone Survey Form

Opening

Hello . . . My name is _____ and I'm calling for the Federal Emergency Management Agency, FEMA. We are talking to residents of *(Name of Community)* and other communities to gather information that will help FEMA evaluate flood measures taken for Hurricane Floyd.

This information is very important, so I was hoping that you would be willing to spend 5 minutes answering a few short questions. Is this a good time?

If yes . . . I really appreciate your willingness to help out. [*Begin questions.*]
If no . . . Is there another time we could talk? [*Schedule a return call*]

---

1. Do you know if your property is in a flood hazard area?

Yes No

If no, continue with Question #3. *If yes, continue with Question #2.*

2. Before Hurricane Floyd hit last September, did you know that your property was in a flood hazard area?

Yes No

If no, continue with Question #3. *If yes, continue by asking Follow-up Question.*

Follow-up Question: **How did you find out that your property was in the flood hazard area?**

DO NOT READ CHOICES. Based on the comments made, check one or more of the following:

- ❑ Asked community official
- ❑ Unsolicited advice from community official
- ❑ Newsletter, flyer or brochure from community
- ❑ Lender
- ❑ Real estate agent
- ❑ Insurance agent
- ❑ Previous owner

❑ Neighbor/friend's advice
❑ Figured it out by myself
❑ Other (briefly summarize):
_____

3. Do you currently have flood insurance on your property?

Yes No

4. Before Hurricane Floyd hit last September, did you have flood insurance on your property?

Yes No

If no, continue with Question #5.
If yes, continue by asking Follow-up Question.

Follow-up Question: **Where did you get the idea/information to buy flood insurance?**

DO NOT READ CHOICES. Based on the comments made, check one or more of the following:

❑ Asked community official
❑ Unsolicited advice from community official
❑ Newsletter, flyer or brochure from community
❑ Lender
❑ Real estate agent
❑ Insurance agent
❑ Previous owner
❑ Neighbor/friend's advice
❑ Figured it out by myself other (briefly summarize):

5. Did your property get flooded during Hurricane Floyd?

Yes No

If no, continue with Question #6.
If yes, continue by asking Follow-up Questions.

Follow-up Question: **Did you file a flood insurance claim because of losses suffered through Hurricane Floyd?**

Yes No

If no, continue with Question #7.
If yes, continue by asking Follow-up Questions.

Follow-up Question: **How much was your flood insurance claim?**

- ❑ 0 - $5,000
- ❑ $5,000 - $10,000
- ❑ $10,000 - $20,000
- ❑ $20,000 - $30,000
- ❑ $30,000 - $40,000
- ❑ More than $40,000

6. Before Hurricane Floyd hit last September, had you taken any steps to protect your property from flood damage?

Yes No

If no, continue with Closing.
If yes, continue by asking Follow-up Questions.

Follow-up Question: **What had you done to protect your property?**

DO NOT READ CHOICES. Based on the comments made, check one or more of the following:

- ❑ Elevated all or parts of the building above flood level
- ❑ Elevated furnace, water heater, air conditioner, etc.
- ❑ Regraded yard or redirected drainage
- ❑ Waterproofed or floodproofed walls
- ❑ Moved damageable contents out of garage or other low area
- ❑ Fixed sewer problem
- ❑ Decided to not make improvements in floodprone area
- ❑ Other:

Follow-up Question: **Where did you get the idea/information to do what you did?**

- ❑ Asked community official
- ❑ Unsolicited advice from community official
- ❑ Newsletter, flyer or brochure from community
- ❑ Lender
- ❑ Real estate agent
- ❑ Insurance agent
- ❑ Previous owner

❑ Neighbor/friend's advice
❑ Figured it out by myself
❑ Researched it/looked in library
❑ Other (briefly summarize):

Follow-up Question: **Did your protection measure(s) prevent or reduce your flood damage?**

Yes No

If no, continue with Closing. *If yes, continue by asking Follow-up Question.*

Follow-up Question: **Approximately how much damage was prevented/money was saved?**

❑ 0 - $5,000
❑ $5,000 - $10,000
❑ $10,000 - $20,000
❑ $20,000 - $30,000
❑ $30,000 - $40,000
❑ More than $40,000

Closing

Those are all the questions I have for you today. I appreciate you taking the time to talk. Goodbye.

Appendix B. CRS Coordinator's Questionnaire

Community Questionnaire **Community:** _____

HMTAPi team member: _____ Date: _____

CRS Coordinator/Interviewee: _____ Phone: _____

1. Approximately how many buildings are there in the community's floodplain?

	SFHA	Flooded by Floyd	
Single-family residences:	____	____	**Collect from local government only if readily available.**
Multi-family residences:	____	____	
Mobile homes:	____	____	
Small businesses:	____	____	
Other (describe):	____	____	
Total:	____	____	

2. What percentage of floodplain residents are considered: low-income _____%
   moderate-income _____%
   high-income _____%

300-series Public Information

3. Which 300-series activities were implemented in your community during the 12 months preceding Hurricane Floyd?

___ 320 Map Information
___ 330 Outreach project to the community (OPC)
___ Outreach project to floodplain residents (OPF)
___ Additional outreach projects (OPA) Describe: _____
_____
_____
_____

___ 340 Disclosure of flood hazard (DFH)
___ 350 Flood Protection Library
___ 360 Flood Protection Assistance
Describe:
___ One-on-one retrofitting advice
___ Site visits

[Collect copies of any papers that describe their program, such as the OPF.]

4. Which, if any, of these activities are effective in:

Telling people about the hazard they are exposed to?

___ 320 Map Information
___ 330 Outreach project to the community (OPC)
___ Outreach project to floodplain residents (OPF)
___ Additional outreach projects (OPA)
___ 340 Disclosure of flood hazard (DFH)
___ 350 Flood Protection Library
___ 360 Flood Protection Assistance

Telling people how to protect themselves from flood damage?

___ 320 Map Information
___ 330 Outreach project to the community (OPC)
___ Outreach project to floodplain residents (OPF)
___ Additional outreach projects (OPA)
___ 340 Disclosure of flood hazard (DFH)
___ 350 Flood Protection Library
___ 360 Flood Protection Assistance

Telling people about flood insurance?

___ 320 Map Information
___ 330 Outreach project to the community (OPC)
___ Outreach project to floodplain residents (OPF)
___ Additional outreach projects (OPA)
___ 340 Disclosure of flood hazard (DFH)
___ 350 Flood Protection Library
___ 360 Flood Protection Assistance

5. Which, if any, of these activities do you think are a waste of time or money?

6. Do you know of any instances where someone installed or implemented a flood protection measure, such as retrofitting or drainage improvements, because of the information or technical assistance provided under one or more these activities? If so, describe:

If the project sounds good and reduced the impact of Hurricane Floyd flooding, get the name, address and telephone number of the property owner. Ask if they would likely be cooperative if we wanted to interview them and take pictures of their property and project. If so, make an appointment, visit the site and complete the form in Attachment C.

Overall Impact of the CRS

7. Which of your CRS activities were started or modified during or after the CRS application?

8. Were they implemented solely for CRS credit or did the community believe that they would help reduce flood losses?

9. Did the new activities have an impact on damage from Hurricane Floyd flooding? If so, how?

10. Have the activities affected other losses from local storms or other flooding? If so, how?

11. For those items that were successful, to what do you ascribe their success?

12. For those items that were successful, would they make good success stories? If so take pictures if appropriate and write a summary of the project and its relation to the CRS.

13. For those items that were not successful, to what do you ascribe their lack of success?

14. Has your community changed the way it is organized for flooding or revised its overall approach to dealing with flood problems since it began in the CRS? For example: is there more inter-staff coordination on flood matters or do the elected officials have a better appreciation for the hazard and different ways to deal with flooding?

15. What is your subjective opinion of the CRS? Has it gotten your community to do things it would not have done otherwise?

Appendix C. Structure Data Sheet

Address:	
Parcel ID:	Owner:

FIRM

Panel Number:	Panel Date:
Flood Zone:	Base Flood Elevation:
Reference Level El.:	Lowest Adjacent Grade:
COBRA (y/n date):	

BUILDING USE

Type:	Description:

CONSTRUCTION

Footprint Area (L/W):	# of Habitable Levels:	
Enclosure (Y/N):	Encl. Footprint (L/W):	
Habitable Sq. Ft:	Encl. Sq. Ft:	Total Sq. Ft:
Construction Date:		

FOUNDATION

☐ Pilings ☐ Square ☐ Round ☐ Wood ☐ Concrete

☐ Slab on Grade

☐ Crawlspace ☐ w/ Concrete Piers ☐ Masonry Piers

BUILDING DAMAGE

Foundation -Pilings

☐ Scour

☐ Fully Exposed ☐ Number

☐ Broken ☐ Number

☐ Connection to Elevated Level Detached

☐ Cross Bracing ☐ Broken

☐ Slab Undermined ☐ Broken ☐ Thickness (in.)

-Foundation Wall

☐ No Damage ☐ Destroyed

☐ Cracked ☐ Piers Damaged

-Slab on Grade	☐	No Damage	☐	Cracked
	☐	Undermined	☐	Destroyed

Enclosure	☐	Walls Damaged	☐	Destroyed
	☐	Electrical Service Damaged	☐	Heating System Damaged
	☐	Plumbing Service Damaged	☐	Cooling System Damaged

Lowest Floor	☐	Walls Damaged	☐	Destroyed
	☐	Electrical Service Damaged	☐	Heating System Damaged
	☐	Plumbing Service Damaged	☐	Cooling System Damaged

DUNE PROTECTION

☐ Is there evidence that a significant amount of dune protection ever existed (Y/N)?

☐ Is there evidence of significant reduction of dune protection (Y/N)?

☐ Is there a significant amount of dune protection remaining (Y/N)?

BUILDING PRACTICE EVALUATION

☐ Were there any relatively poor or good building practices associated with this structure?

Description: _____

_____

_____

CONDITION OF PILES

☐ Good ☐ Poor ☐ Extremely Poor

Appendix D. Flood Warning Program Questionnaire

County: _____

HMTAPi team member: _____ Date: _____

Person interviewed: _____

Address: _____

_____

Phone: _____

The purpose of this survey is to determine if changes to the local emergency operations procedures following Hurricane Fran made a difference in the capability of the community to respond during Hurricane Floyd. This may have been through improved coordination, better recognition of the potential threats, improved warning or an enhancement of local capability to reduce potential losses.

Plan Review:
Which agencies participated in the Emergency Operations Plan review?

Flood Threat Recognition:
What problems, if any, were identified with your flood threat recognition system?

What recommendations were made to correct these problems?

Have these recommendations been implemented?

Emergency Warning Dissemination:

Were there deaths or major injuries during Hurricane Fran? If yes, how many? What happened?

What about deaths or major injuries following Hurricane Floyd? If yes, how many? What happened?

What methods of advanced warning to the public were used during Hurricane Floyd? Identify.

Did your community experience problems with residents or businesses not receiving adequate advanced warning? Describe.

Are there businesses or residential areas identified in your plan that need more advanced warning than the community generally receives? If so, were there any problems in providing this advanced warning during Hurricane Floyd? Describe.

During Hurricane Fran were additional businesses or neighborhoods identified as needing more advanced warning? Have arrangement for this advanced warning been incorporated in your local emergency management plans or SOPs? Identify.

Emergency Operations Procedures

Does the local emergency operations plan or SOPs identify specific tasks to be completed during a flood event? If yes, identify.

Are these tasks keyed to specific forecast flood levels? If yes, describe.

Are any of these tasks directly related to saving property or reducing property losses? [Flood fighting, floodproofing, elevating or moving contents, etc.] If yes, describe.

Are there examples of actions taken during either Hurricanes Fran or Floyd to reduce flood losses? If yes, describe.

[Based on these answers a visit may need to be made with businesses to obtain more information on the actions taken and the flood loss reduction benefits.]

Critical Facilities

Are there critical facilities that need advanced warning when the community is threatened with a flood? Identify.

Were facilities added to this list as a result of problems identified during Hurricane Fran? If so, which ones, why and what actions are taken by the facility operators?

Do any of these critical facilities have action plans that are directed to reducing flood losses? Identify.

How do these facilities receive their advanced warning?

[Based on these answers a visit may need to be made with the facility operator to obtain more information on the actions taken and the flood loss reduction benefits.]

Additional Changes Needed:

Are there other lessons learned and changes needed in the warning program and response plan?

Appendix E. Dam Safety Questionnaire

County: _____

HMTAPi team member: _____ Date: _____

Person interviewed: _____

Address: _____

_____

Phone: _____

The purpose of this survey is to determine if a dam failure warning plan was adopted by a community, if a warning was received by the community, if the dam failure warning procedures were implemented by the community, and if the procedures were effective in protecting the population.

Hurricane Floyd:
Did your community receive a warning about an imminent or recent dam failure during or after Floyd?

Did a dam failure during Floyd affect your community?

If so, how?

Plan Adopted?:
Was the dam failure response plan adopted by the Council or Commission? If so, when?

Is the response plan keyed to specific dam failure inundation levels?

What is the source of these predicted inundation levels?

Are all upstream dams which might affect a particular stream (or the entire community) reflected in the dam failure response plan?

Does the community receive regular (annual) reports on the condition and status of up-stream dams?

Can the community regularly (monthly) communicate with the dam operators?

Are there regular (annual) exercises of the community's emergency response plan?

Flood Threat Recognition:
How do you receive dam failure warnings? How did you receive a warning during Floyd?

What problems, if any, were identified with your dam failure threat recognition system?

How much warning time did your community have between the warning and the dam failure?

Emergency Warning Dissemination:
What methods of advanced warning to the public were used during Hurricane Floyd? Identify.

Did your community experience problems with residents or businesses not receiving adequate advanced warning? Describe.

Are there businesses or residential areas identified in your plan that need more advanced warning than the community generally receives? If so, were there any problems in providing this advanced warning during Hurricane Floyd? Describe.

Emergency Operations Procedures
Does the local emergency operations plan or SOPs identify specific tasks to be completed by community staff and/or agencies during a flood event? If yes, identify.

Are these tasks keyed to specific forecast flood levels? If yes, describe.

Are any of these tasks directly related to saving property or reducing property losses? [Flood fighting, floodproofing, elevating or moving contents, etc.] If yes, describe.

Are there examples of actions taken during either Hurricanes Fran or Floyd to reduce flood losses? If yes, describe.

[Based on these answers a visit may need to be made with businesses to obtain more information on the actions taken and the flood loss reduction benefits.]

Critical Facilities

Are there critical facilities that need advanced warning when the community is threatened with a flood? Identify.

Were facilities added to this list as a result of problems identified during Hurricane Fran? If so, which ones, why and what actions are taken by the facility operators?

Do any of these critical facilities have action plans that are directed to reducing flood losses? Identify.

How do these facilities receive their advanced warning?

[Based on these answers a visit may need to be made with the facility operator to obtain more information on the actions taken and the flood loss reduction benefits.]

Additional Changes Needed:

Are there other lessons learned and changes needed in the warning program and response plan?